

Motorship

Registered in U. S. Patent Office and abroad

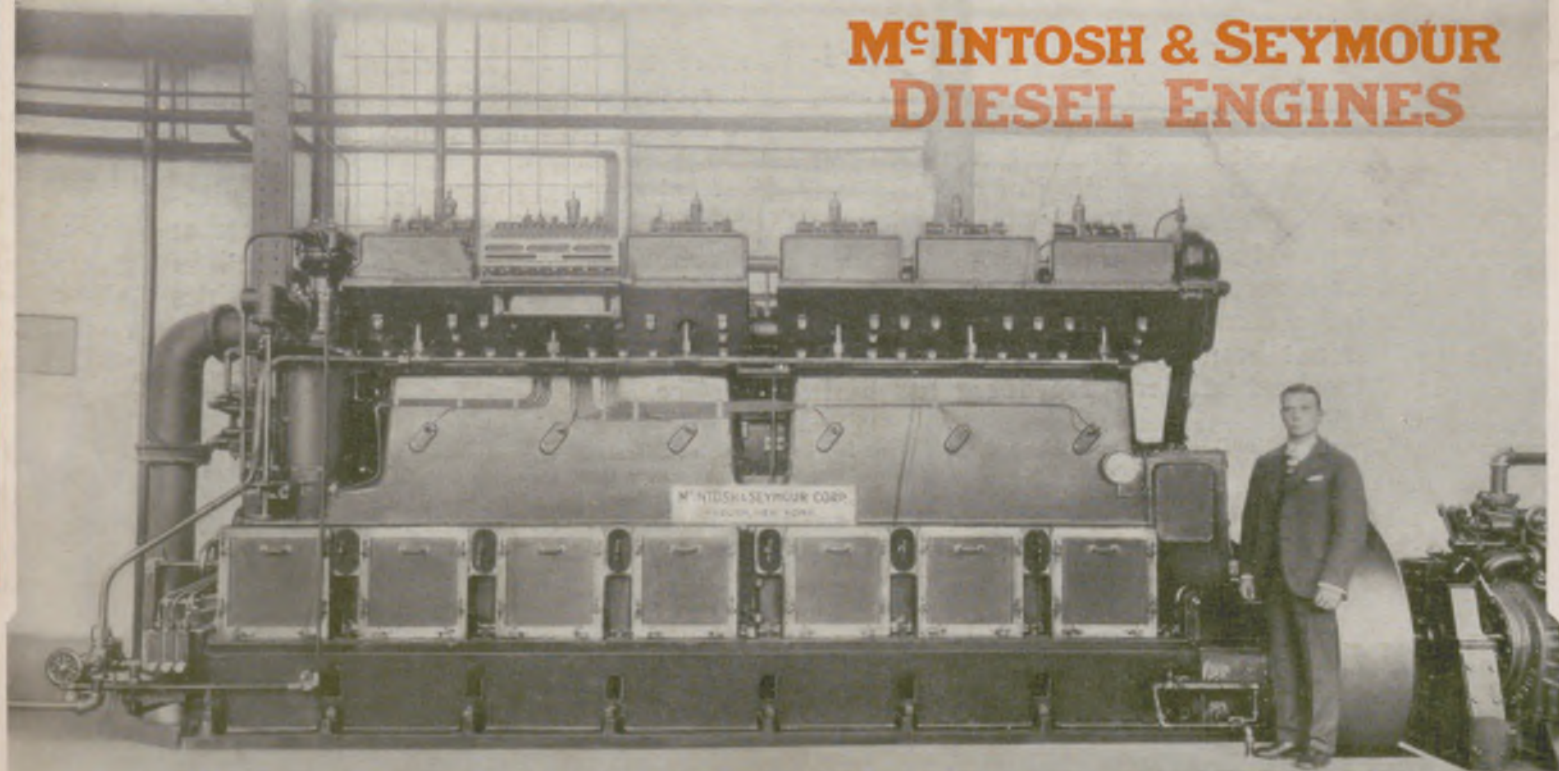


For ferry boats, harbor tugs, tankers and barges

THE New York Central Railroad bought two of these 400 hp. units for one of the largest Diesel-electric-driven tugs in New York Harbor.

—because speed, dependability, fuel economy, a wealth of power, and low operating costs are assured by

McINTOSH & SEYMOUR DIESEL ENGINES



OCT. 1926

PRICE 35c

ARTICLES on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

Motorship

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ILLUSTRATIONS of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

Vol. XI

October, 1926

No. 10

Six Years' Oil Supply or Six Hundred?

No Danger of Shortage in U. S., states Government Report
Which Trapped Newspapers Into Scare Headlines
About Oil Famine

THERE is no oil shortage; there is no impending oil famine; nor is there any economic or scientific justification for alarm about the U. S. oil supply in the future.

This is admitted in the Preliminary Report of the Federal Oil Conservation Board, the very same report that trapped many newspapers throughout the country to announce on Labor Day in big scare headlines that there is only a six years' oil supply in the United States.

That these contradictory statements can be taken from a single Government Report

is startling yet true. The newspapers have justification for their action: the Government has its alibi. Such is the mess that has been made of the compilation of that Report.

Materially the Report, which appeared in the form of a 30-page multigraphed release, may be summarized as containing:

- 1 p. Introduction.
- 8 p. Oil supply and reserves.
- 9 p. State or Federal regulation.
- 3 p. Dept. of Interior oil lands.
- 2½ p. National Defense.
- 2½ p. Improved Recovery and use of oil.

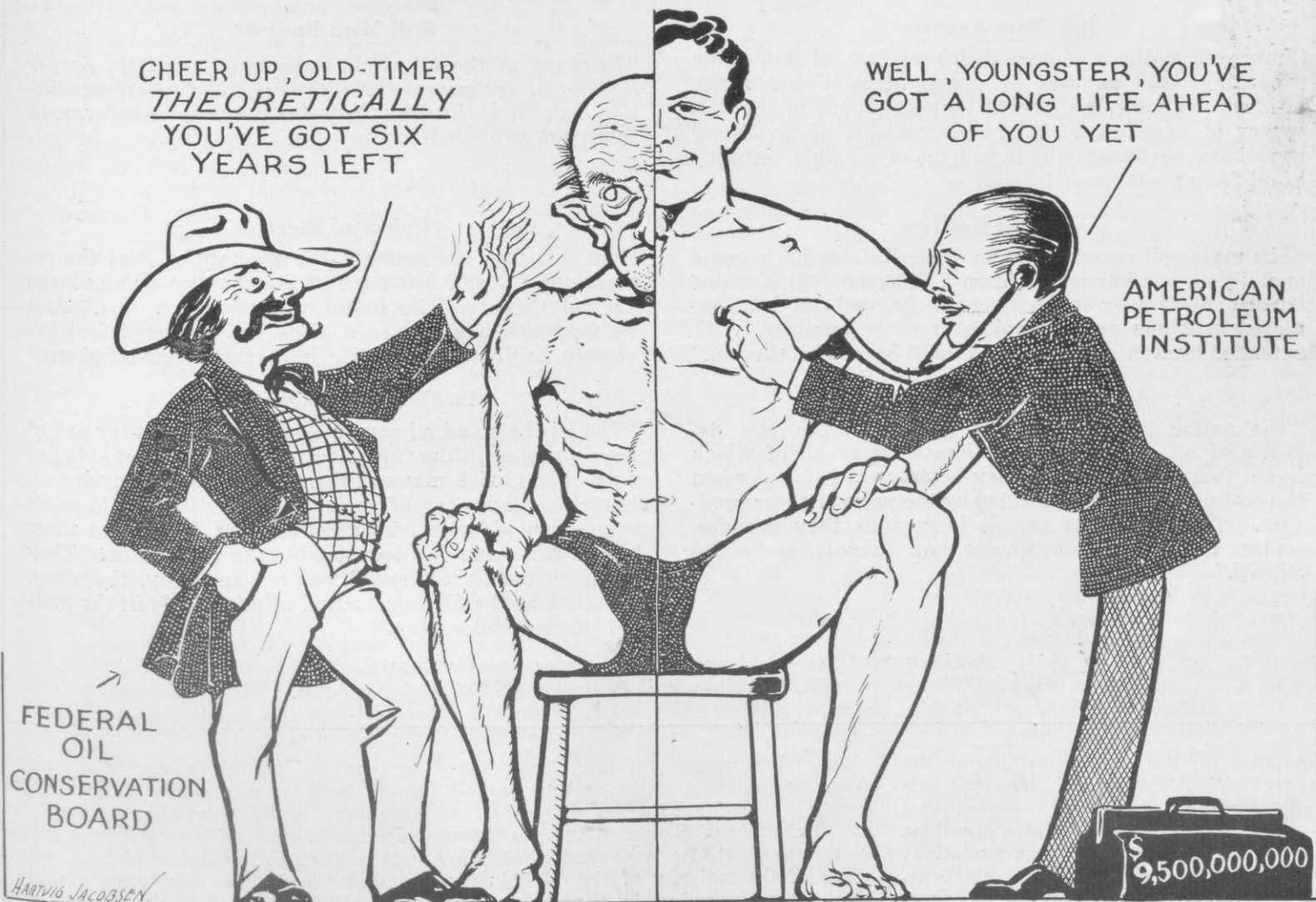
½ p. Foreign Supplies.

1 p. "How to Succeed in Business."

2½ p. Continuation of Board's work.

This analysis of the contents demonstrates that the larger part of the Report is political in character. Just about one quarter relates to the broad question of the oil supply, which involves one of the vastest industries in the country, giving livelihood to about ¾ million workers and with a capital investment computed variously at 9-9½ billion dollars (\$9,000,000,000-\$9,500,000,000).

Where did the Government seek its in-



Motorship's cartoonist depicts U. S. oil supply as Federal Oil Conservation Board represents it and as American Petroleum Institute knows it.

Short Cuts Made by the Government's "Scientific Men Burdened by Exacting Daily Routine Duties"

From the Report
of the Committee of Eleven
of the American Petroleum Industry.

August, 1925.

Business Facts

"For facts as to the future supply the Committee went to *the industry itself, as best qualified* through its knowledge and experience, for estimates of the volume of oil which may be expected from existing fields, for prediction as to probable discoveries of new fields. . . ."

Immediate Reserves

"Petroleum recoverable by *present methods of flowing and pumping from existing wells* and acreage thus proven consist of five billion three hundred million (5,300,000,000) barrels of crude oil."

The Future

"There is *no imminent danger of the exhaustion* of the petroleum reserves of the United States."

Much Bigger Reserves

"It is estimated that after pumping and flowing there will remain in the area now producing and proved twenty-six billion (26,000,000,000) barrels of crude oil, *a considerable portion of which can be recovered* by improved and known processes. . . ."

Still More Reserves

"Improved methods of *deep drilling below oil sands* now producing will disclose in many areas deposits not hitherto available, which will be tantamount to the discovery of new fields. Improved methods of producing have been perfected which will make possible recovery of oil from these lower levels."

Unlocated Reserves

"The major oil reserves of the United States lie in some one billion, one hundred million (1,100,000,000) acres of lands underlain by sedimentary rocks, and not fully explored in which geology indicates oil is possible. With extended search *new supplies will be found* therein."

An Almost Unlimited Supply

"The nation has an addition reserve in the vast deposits of oil shale, coal and lignites from all of which liquid fuel and lubricants may be extracted if and when the cost of recovery is justified by the price of these products. These deposits are so huge that they promise, under conservative estimates, *an almost unlimited supply*."

*The quotations are from the respective reports named.
The paragraph headings and italics are MOTORSHIP'S.*

From the Preliminary Report
of the Federal Oil Conservation
Board.

September, 1926.

Chairman's Apology

"It is hoped that this preliminary report, conscientiously prepared under the direction of this Board by *scientific men burdened by exacting daily routine duties*, may furnish a concise picture of the true conditions as determined by the inquiry of this Board."

—Hubert Work, Chairman of the Board.

Immediate Reserves

"The total *present reserves in pumping and flowing wells* in the proven sands has been estimated at about 41½ billion barrels. . . ."

The Future

". . . which is theoretically *but six years' supply*, though, of course, it cannot be extracted so quickly."

Much Bigger Reserves

"While no positive assurance can be given from the results so far attained, yet it is the impression that developments have proceeded so far as to give strong belief in *considerable further recovery* from the known sands over and above the estimates which have been made as to the supplies available by present methods."

Still More Reserves

"As many of the oil sands slope into the earth, *deeper drilling of known sands* will bring still further production, as well as the discovery of deeper sands underneath those now exploited."

Unlocated Reserves

"But this does not warrant the assumption that the remaining 1,100,000,000 acres of the country, or any large part of them, will be found oil bearing. . . . And we may conclude that *such fields will be found*, but obviously no forecast of their importance can be given."

An Almost Unlimited Reserve

"The oil shale and oil sand deposits of the country are of more promise in the future outlook. Very large areas of such shales exist, many of them containing as much as a barrel of oil per ton of shale. Their utilization is solely a question of price. There can be no doubt that these shales will some day be brought into production. They form *an almost unlimited reserve* and may, therefore, be taken as the final protection of our people in the matter of essential supply."

formation for the business section of the Report? What exactly are the views officially expressed about oil supplies and reserves? The answers to these questions are supplied by a study of the quotations set out in the box above on this page. Read the quotations paragraph by paragraph and column by column.

The Government's "scientific men burdened by exacting daily routine duties" have not really thought any differently to the Committee of Eleven of the American Petroleum Institute who expressed the views of the majority of the oil industry just 12 months earlier—in August, 1925.

The big exception is that instead of sub-

scribing to the oil industry's statement that "there is no imminent danger of the exhaustion of the petroleum reserves" the Government's scientific men gave a prominent position to the statement ". . . which is theoretically but six years' supply," although this applied to the smallest part
(Continued on opposite page)

Two Motor 'Mauretanas' Now Building

Cosulich Line Constructing Motorships Which Will Equal
in Speed Anything on the Atlantic

COSULICH LINE is to construct immediately at the Monfalcone Shipyard, Trieste, two passenger motorliners for the North Atlantic trade, which, when completed, will not only be the largest and fastest motorships in the world, but in size and speed will be practically equals of MAURETANIA, at present the fastest ship on the Atlantic. This arrangement and construction includes many features not found on any other passenger ships.

The placing of orders for these vessels marks one of the most important stages in the evolution of the motorship yet reached, and indicates that the Diesel is capable of handling powers and giving speeds hitherto considered entirely within the realm of the steam turbine.

A speed of 24 knots at sea is to be realized with 42,000 s.h.p. distributed to four lines of shafting. Each shaft is operated by two 10-cylinder, single-acting, 2-cycle Fiat Diesels, arranged in tandem and connected to each other by means of an hydraulic coupling, so that if necessary four of the eight main engines can be cut out almost instantaneously—in the event of, say, breakdown, or the desire to cruise economically at slow speeds. All auxiliary machinery is electrically driven. Cosulich Line states that the single-acting, 2-cycle engine is ideal for their particular purpose, because of its compactness and because it

does not absorb much headroom, leaving clear deck spaces for passenger accommodation for 2700 people—350 first class, 450 second class, 600 intermediate class, and 1300 tourist cabin class. The crew numbers 500.

Cosulich Motorliner Characteristics

Length on waterline.....	715 ft. 0 in.
Length, overall.....	742 ft. 6 in.
Beam, extreme.....	85 ft. 4 in.
Beam, molded.....	84 ft. 0 in.
No. of decks.....	10
Depth to strength dk.....	60 ft. 0 in.
Draft.....	30 ft. 0 in.
Gross Tonnage.....	33,000 tons
Power.....	42,000 s.h.p.
Fuel capacity.....	3700 tons
No. of stacks.....	2
No. of main engines.....	8
No. of cyls. per engine.....	10

The speed of 24 knots is 4 knots in excess of that of Ss. PRESIDENTE WILSON, Cosulich present flagship in the Trieste-New York service and 2 knots in excess of that of VULCANIA and SATURNIA, motorliners building for the Trieste-South American run, which will in all probability be diverted temporarily to the New York run. The fuel capacity is sufficient to take the ships about 10,000 miles without refuelling, and it is expected that the total consumption will be in the region of 175 tons per day.

Not only is the power in excess of that of any motor layout at present building (Vulkan Werke have a 42,000 s.h.p. layout, with sixteen engines driving four shafts, four engines coupled to each shaft through Föttinger hydraulic clutches, but this has not been constructed), but the speed with this power is obtained largely through a special hull form, which incorporates a ram bow of old-time battle ship type, bulbous in waterline section. This increases the waterline length to that figure best suited to the optimum wave profile and decreases the hull resistance 5 per cent at maximum speed. The stereotyped hull form has thus been entirely departed from.

The arrangement of accommodation offers many novel features, chief among which is that one complete deck is devoted exclusively to all the dining saloons and restaurants, with their respective galleys and pantries. The height between this "dining deck" and the deck next above is 11 ft. The topmost deck of all is a sports deck, containing a tennis court, bowling alley and other similar features; it has also arrangements for two seaplanes, which the ship is to carry to enable passengers on urgent business to cut the time to their destination when the ship is approaching port. All officers, engineers and deck have their cabins on a special staff deck under the sports deck.

Six Years Oil Supply or 600?

(Continued from opposite page)

of the reserve oil supply. That made the big hit with the newspapers.

With this exception, the main reasoning and conclusions of the published report of the American Petroleum Institute's Committee has been followed, the similarity extending not only to the expression of ideas, but in some instances to the use of the same words.

Surprise follows surprise as one notes that notwithstanding the "six years" scare the Federal Oil Conservation Board's Report admits one bigger group of oil reserves after another, culminating in the "almost unlimited reserve" of oil in the oil shale and oil sand deposits of the country.

That is enough. The conclusions of the Committee of Eleven of the American Petroleum Institute—the voice of the oil industry—stand endorsed by the Federal Oil Conservation Board, the President's own Board, nominated by him and composed of the Secretaries of the Interior, of War, of the Navy and of Commerce.

After all the ballyhoo about the national importance of the inquiry to be conducted by the Board there is no evidence that it has undertaken any original investigation; it has not added one iota to previous knowledge or thought about the oil reserves and its first official expression of opinion has served to mislead the public very grossly.

It has not challenged the figures of the

American Petroleum Institute's Committee of Eleven. On the contrary it has used them. The Government figure of 4½ billion barrels in pumping and flowing wells is the American Petroleum Institute's figure of one year ago, minus the intervening 12 months' consumption of about ¾ billion (750,000,000) barrels.

Moreover, there is a lack of frankness in the Government Report. No reference to computations of oil reserves should have been made at all, without a very clear explanation of the fact—which the nation at large certainly does not know—that these figures are not exact measurements, but represent only the mean of the predictions which leading petroleum geologists have been willing to make on the basis of their experience. Obviously, in the case of the pumping and flowing wells the experience of the geologists permits an estimate to be made that cannot be far in error. In all other cases the margin of possible error increases with the lack of knowledge.

The Government Report should have stated that the various U. S. oil reserve estimates compiled between 1908 and 1921 by the U. S. Geological Survey (Dept. of Commerce) have each in turn been exceeded by production, with more oil in proven acreage than ever before. No wonder the A. P. I. Committee of Eleven satirically remarked that the history of past estimates would permit the conclusion "that the more oil we take out of the ground, the larger our reserves become."

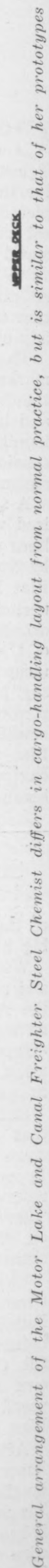
This same thought is sounded in our

headline: "Six Years' Oil Supply or 600?" The quotation from the Government Report referring to "an almost unlimited reserve" would indeed justify 6000 years or 60,000 years instead of 600 years.

When the Federal Oil Conservation Board wrote about the 6 years' oil supply, frankness would have dictated that attention should be drawn to the fact that (1) the oil industry could not have been expected to have already drilled the immense unproved acreage of the United States, that (2) it is unlikely the keen minds which direct the employment of more than 9 billion dollars capital in this industry are jeopardizing the investment by failing to look more than "six years" ahead and that (3) the leaders of the oil industry itself have total confidence in the future. The Government Report on the contrary gives the impression that a political effort is being made to create mistrust of the oil industry.

Another section of the Report affects the oil industry, that being the section in which the extent of possible State and Federal regulation of oil production is discussed. It is the harness of Hoover's favorite hobby horse: elimination of waste by cooperation in the industry.

Intrinsically the hobby is a worthy one and Hoover has accomplished much by it already, but here it seems to be getting into dangerous company and should be watched. When industrial cooperation and police powers of the State are discussed in the same chapter it seems like an omen of trouble ahead.



First Small Double Acting Diesel

Ms. Steel Chemist, Now on Lakes, Is Pioneer Ship
with New Development in Propulsion

PROPELLED by a 3-cylinder double acting 2-cycle Diesel, ms. STEEL CHEMIST is one of the most noteworthy ships operating on the Great Lakes at the present time. Her main engine developing 950 b.hp. at 165 r.p.m. is the only moderate sized double-acting Diesel at present fitted in any motorship in the world. Entry of the STEEL CHEMIST into the Great Lakes trade, therefore, has a significance which is not confined to the Lakes themselves, but which should have far reaching effects in the marine industry in this country as a whole, in view of the many domestic ship types to which this type of engine is particularly suited.

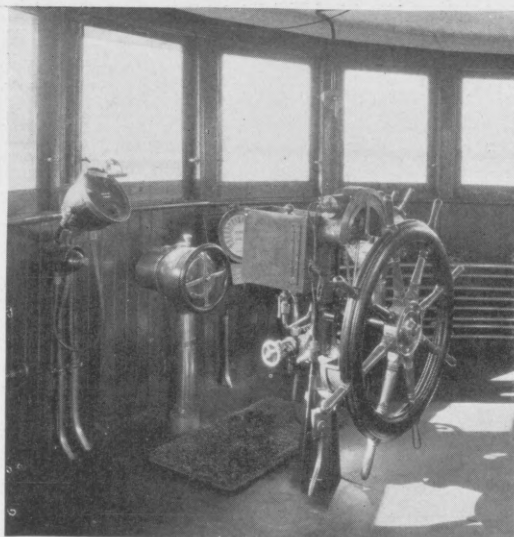
The vessel is the last of four exactly similar freighters with dissimilar machinery equipment built by Federal S. B. Co., Kearny, N. J., for the U. S. Steel Products Company, and like her prototypes STEEL-MOTOR and STEELVENDOR built in 1923, and STEEL ELECTRICIAN completed early this year, is intended specifically for the transportation of steel plates and shapes from the U. S. Steel Corp. mills in the Chicago district to Montreal, Canada. Limited by

the dimensions of the Welland Canal locks through which they pass round Niagara Falls on the Canadian side from Lake Erie to Lake Ontario, these motorvessels of the U. S. Steel Products Co. are not large com-

pared with the big ore carriers operating west of Buffalo, but they are of the maximum size possible in the U. S.-Canadian trade on the Great Lakes.

The only difference between STEEL CHEMIST and her three sisters is the propelling machinery, because the hulls of all four ships are exact duplicates. STEEL-MOTOR and STEELVENDOR are each propelled by a 6-cylinder McIntosh & Seymour Diesel of trunk piston type rated at 960 i.hp., direct coupled to the propeller shaft. STEEL ELECTRICIAN is electrically driven, having three generator sets, each comprising a 300 b.hp. Nelseco Diesel direct connected to a 200 kw. Westinghouse generator. These sets supply current to a 750 hp. electric propelling motor running normally at 135 r.p.m. STEEL CHEMIST has a Worthington double acting 2-cycle engine of 950 b.hp.

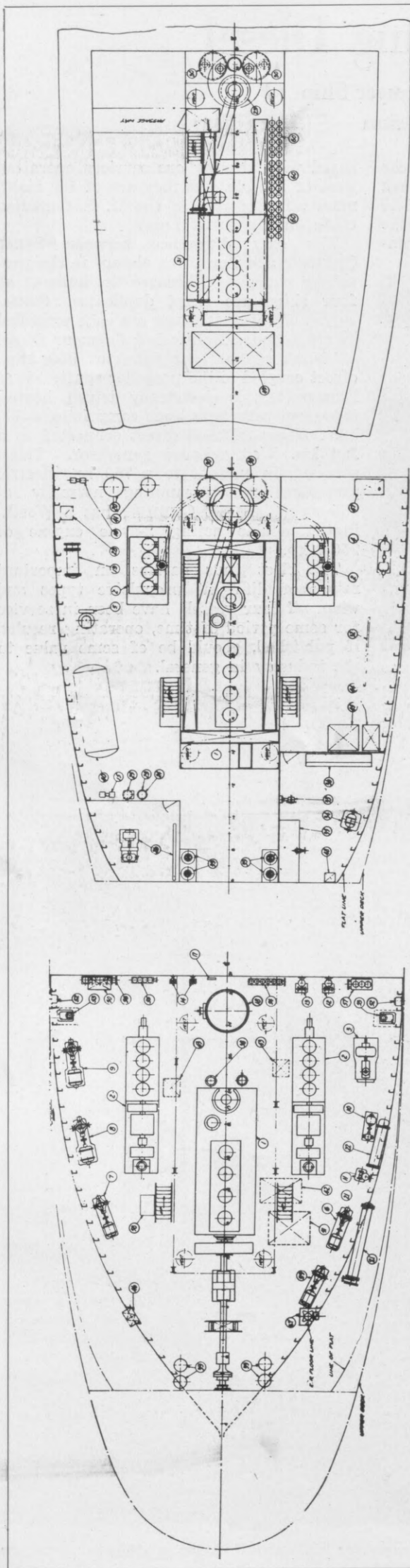
The fleet thus carries an important range of different propulsive types and when all four vessels have been in service for some period of time, operating results, if published, should be of some value to the industry in general.



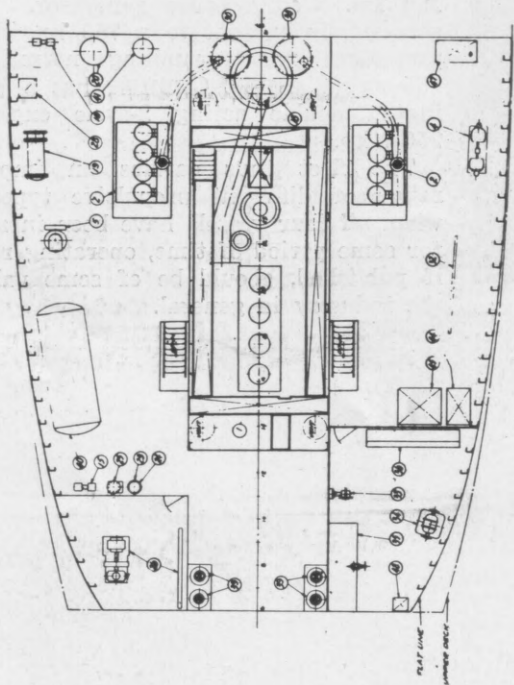
Gyro and hydro-electric steering



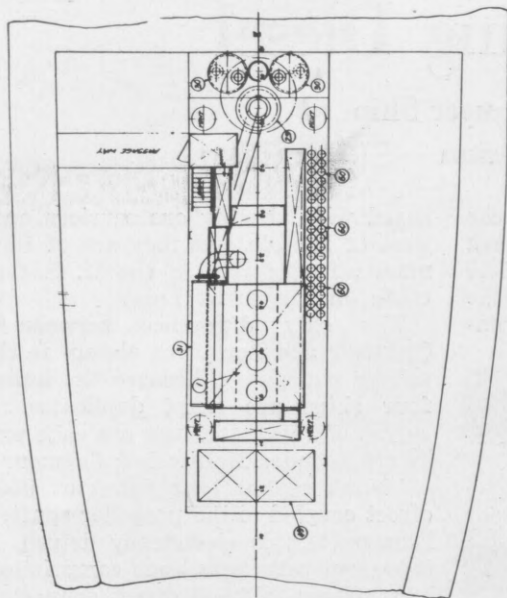
Ms. Steel Chemist, propelled by a double acting 2-cycle Diesel, has special deck cranes for loading steel shapes at Chicago



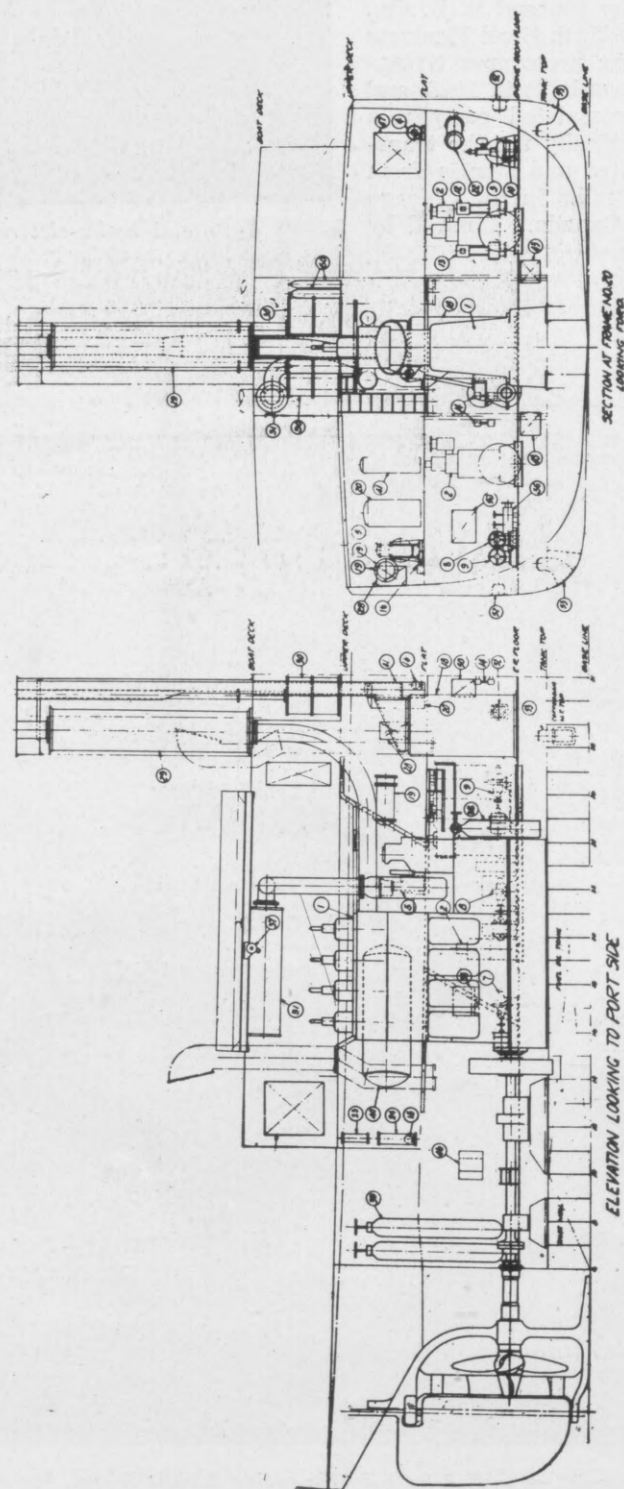
PLAN AT ENGINE ROOM FLOOR



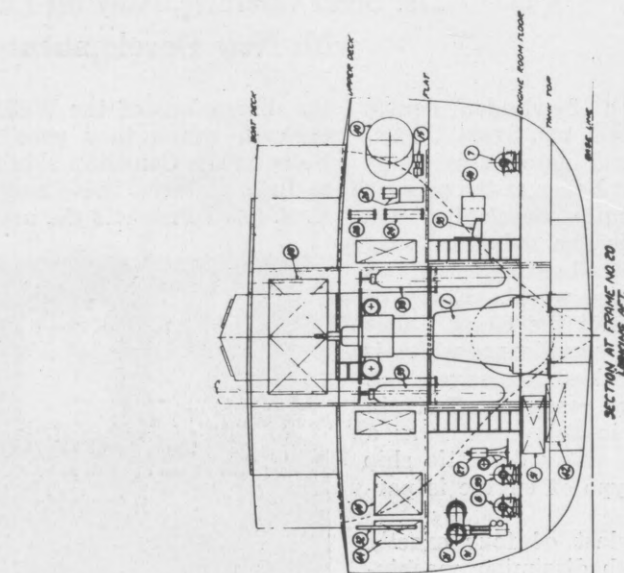
PLAN AT FLAT



PLAN AT UPPER DECK



ELEVATION LOOKING TO PORT SIDE

SECTION AT FRAME NO. 20
LOOKING AFT

General arrangement of Ms. Steel Chemist's machinery space shows the compactness of her double acting main propelling unit and the ample working space around

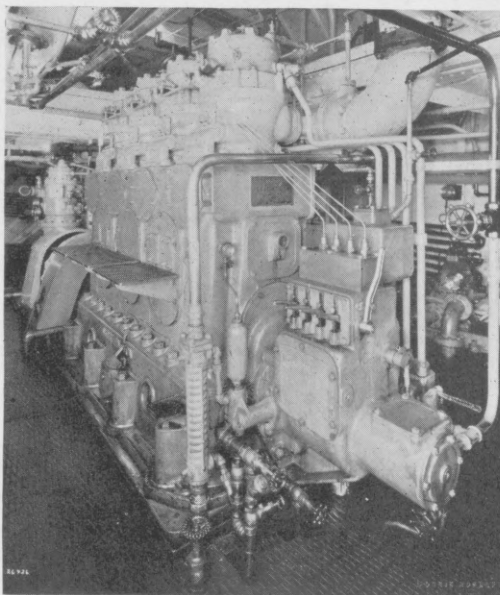
- | | | | | | |
|--------------------------------|---|---|-----------------------------------|--|-----------------------------------|
| 1—Main engine | 11—Lub. oil transfer pump. | 21—F. w. cooler. | 31—Scavenge pump intake silencer. | 41—Whistle air tank. | 51—F. w. drain tank. |
| 2—(2) Main gen. sets. | 12—Fuel oil transfer pump. | 22—Lub. oil cooler. | 32—Switchboard. | 42—Lub. oil drain tank (main engine). | 52—(2) High sea chests. |
| 3—Aux. gen. set. | 13—Bilge and emergency o. f. transfer pump. | 23—Distiller. | 33—Hand drill press. | 43—(2) Lub. oil drain tank (aux. engines). | 53—(2) Low sea chests. |
| 4—Motor gen. set. | 14—(2) Donkey boiler feed pumps. | 24—Evaporator. | 34—Grinder. | 44—Lub. oil settling tank. | 54—Bilge manifold. |
| 5—Emergency air comp. | 15—Distilled water pump. | 25—Ice machine and condenser. | 35—Work bench. | 45—Lub. oil storage tank. | 55—Ballast manifold. |
| 6—F. w. circ. pump. | 16—Hot water circ. pump. | 26—Lub. oil purifier. | 36—Bins. | 46—Engine oil tank. | 56—Ballast manifold wing suction. |
| 7—S. w. circ. pump (port use). | 17—Donkey boiler feed injector. | 27—Lub. oil purifier. | 37—Trolley chain and hoist. | 47—Kerosene tank. | 57—Fuel oil cock manifold. |
| 8—S. w. circ. pump (sea use). | 18—Donkey boiler. | 28—Inspection tank. | 38—(2) Injection air flasks. | 48—Clean waste tank. | 58—Fuel oil wing suction. |
| 9—Fire and g. s. pump. | 19—Condenser. | 29—Main engine exhaust silencer. | 39—(4) Maneuvering air flasks. | 49—Fuel oil daily service tank. | 59—F. w. circ. pump. |
| 10—Lub. oil pump. | 20—Hot water storage heater. | 30—(2) Generator engine exhaust silencer. | 40—Maneuvering air tank. | 50—Feed and filter tank. | 60—Fire ext. bottles. |

Characteristics of Steel Chemist

Length overall	257 ft. 11½ in.
Length, b. p.	250 ft. 0 in.
Beam, molded	42 ft. 9 in.
Depth, molded	20 ft. 0 in.
Draft, Lake service	14 ft. 0 in.
Draft, Coastwise	16 ft. 0 in.
Deadweight (light)	2077 tons.
Gross tonnage	1694 tons.
Power	950 b.hp.

STEEL CHEMIST has four watertight bulkheads, the aft peak bulkhead abaft the machinery space, the forward machinery space bulkhead, one bulkhead at mid-length of the cargo space, and the fore peak bulkhead at the fore end of the cargo space. The double bottom extends throughout the ship's length and contains two water ballast tanks under the cargo space and fuel oil tanks under the machinery space. There is one continuous deck, the upper deck, having a short f'c'sle containing accommodation for deck officers and crew, at the fore end. Above this f'c'sle is a small house containing the captain's stateroom and above this again is the pilot house. Engineer officers are accommodated around the engine casing aft. The vessel has the usual Lake type hull with recessed hawse pipes and Lake type semi-balanced rudder. Like her sister ship STEEL ELECTRICIAN, STEEL CHEMIST has a contra-propeller.

Each of the cargo holds is about 80 ft. long and each has a hatch measuring 40 ft. x 20 ft. Into both holds therefore steel plates, structural shapes and rails of large length can be loaded. For lifting and swinging these large lengths special handling provisions are made. The usual winches and booms common on ocean shipping are supplanted by two 5-ton electric revolving cranes of the standard design of the Brown Hoisting Machinery Co. of Cleveland, Ohio, of a type generally used on land as locomotive cranes. These cranes are more powerful than would be necessary for handling general cargo. Classification of STEEL CHEMIST with the American Bureau of Shipping permits of her being used in coastwise service and the ves-



Auxiliary generator-compressor set

sel's maiden trip was actually a coastwise voyage. After leaving her builders' yard at Kearny she proceeded straight to Philadelphia where a cargo of sugar was loaded for Chicago.

The engineroom layout is a neat one, and does not in any way convey the impression of main or auxiliary machinery being crowded. In point of fact exactly the same length of engine room is used as was used on the other vessels, although with the double acting engine it would have been possible to clip 5 ft. or 6 ft. off the length, but it was judged easier for standardization purposes to make all four vessels exactly the same, because this would entail no alteration of templates used in the structural work in the shipyard.

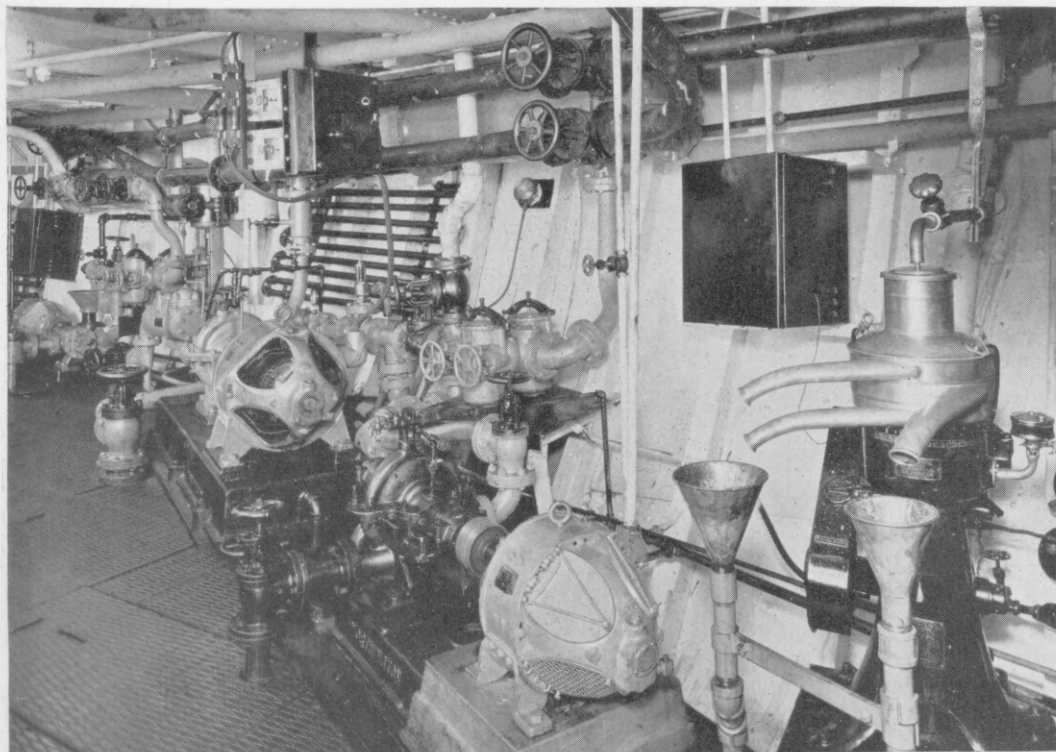
The Worthington engine develops its power at 165 r.p.m. and gives the loaded ship a speed of about 9 knots. It drives a solid manganese bronze propeller 9 ft. 6 in. diameter by 7 ft. 0 in. pitch through a thrust shaft 10¼ in. diameter and 9 ft. 2 in. in length and a tailshaft 11 ft. 7¼

in. in length. The engine is direct reversible and controls are arranged at the forward end at floor level, communication with the bridge being by means of mechanical engine-room telegraphs. On either side of and slightly forward of the main engine are two 4-cylinder Diesels each driving a generator and a compressor through a magnetic clutch. On the port side are two salt water circulating pumps, and a fire and general service pump. On the starboard side are located a centrifugal lubricating oil purifier, two fresh water circulating pumps, lubricating oil standby and transfer pump, and a rotary lubricating oil pump. Here is also a 7½ kw. emergency generator set driven by a kerosene engine. A small donkey boiler 5 ft. 9 in. diameter by 9 ft. high is located on the center line at the forward end of the engineroom. Exhausts from the main engine and from the two auxiliary engines are taken up through mufflers into a normal sized stack at the forward end of the engine casing.

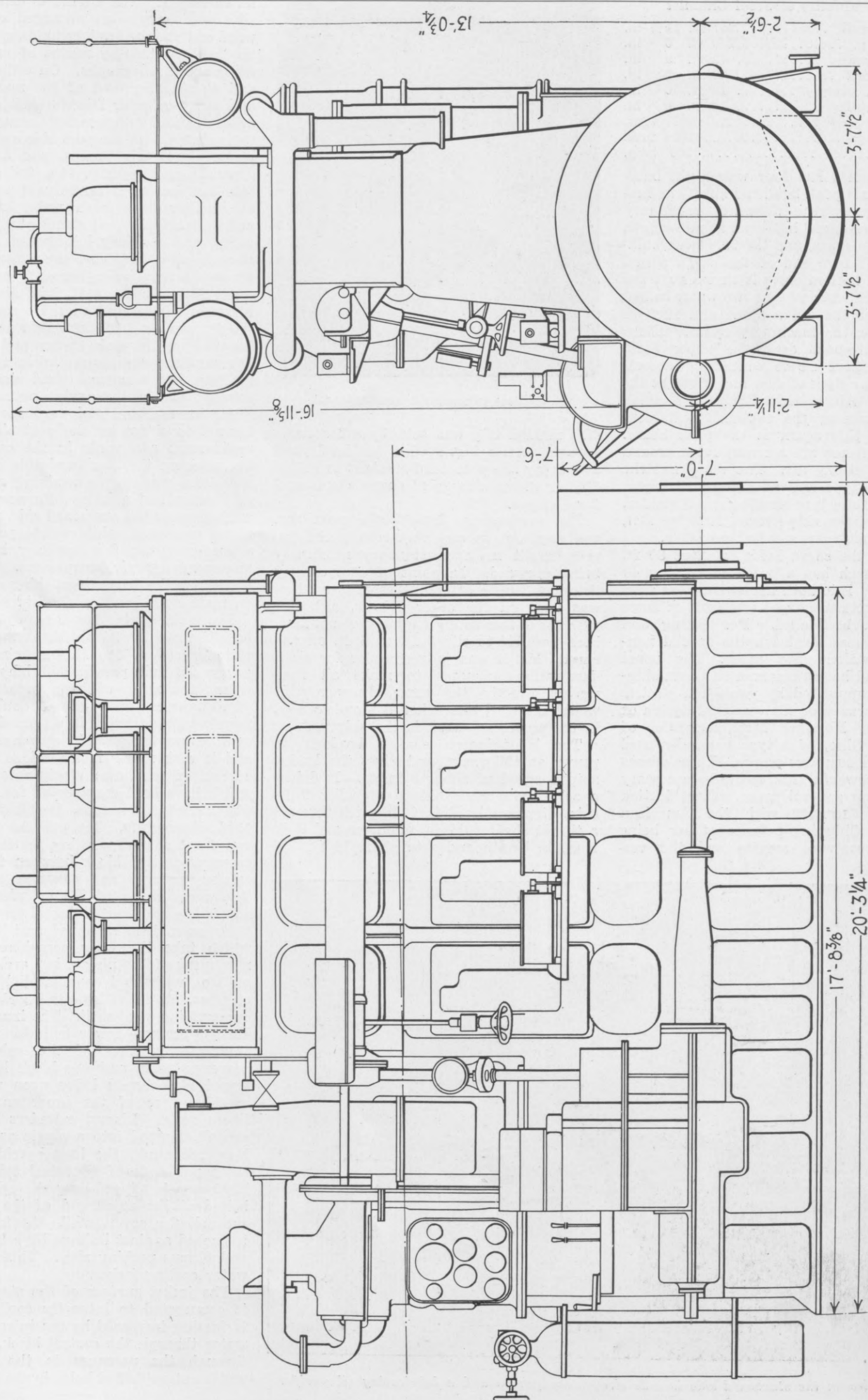
An ice machine and condenser are arranged on a flat on the port side of the engineroom aft, while in the corresponding place on the starboard side is a small well-fitted workshop containing a grinder, drill press and a lathe. Forward of this workshop, on the starboard side, is a small motor generator, while on the port side is a condenser for the auxiliary boiler and an emergency air compressor. Lux CO₂ bottles for the fire extinguishing system are on main deck level on the starboard side.

The main engine has three cylinders, 16 in. diameter by 24 in. stroke. It has a piston speed of 660 ft. per min. and develops its full power, 950 b.hp., at 165 r.p.m., the mean effective pressure being 62 lbs. per sq. in. It is of double acting 2-cycle type with air injection, driving its own compressor and scavenge pumps, and is with minor modifications a smaller edition of the large Worthington engines which have been constructed for the Shipping Board conversions, described in April, 1926, MOTORSHIP. The cylinder comprises two dome shaped working portions with a common central block between them containing exhaust and scavenge air ports. The dome shape of the cylinder ends is adapted to withstand internal pressure, and their extensions enshroud cast-iron liners which take the wear occasioned by the movement of the piston, but are not called on to withstand any radial pressure stresses, all of which are carried by the surrounding steel shell. The inner ends of both upper and lower cylinder liners are thickened in way of the exhaust and scavenge ports and the block has an internal ring-shaped ledge upon which the machine face of the inner ends of the liners rests. Liners, cylinders and block are all clamped into a single assembly by lugs and studs, the lugs bearing against the inner ends of the steel cylinder. A light case is slipped over the cylinder and bolted at the outer end of the flange of the cylinder cover, while the inner cover is packed against leakage by a light gland and fibrous packing ring. This forms the water cooling jacket.

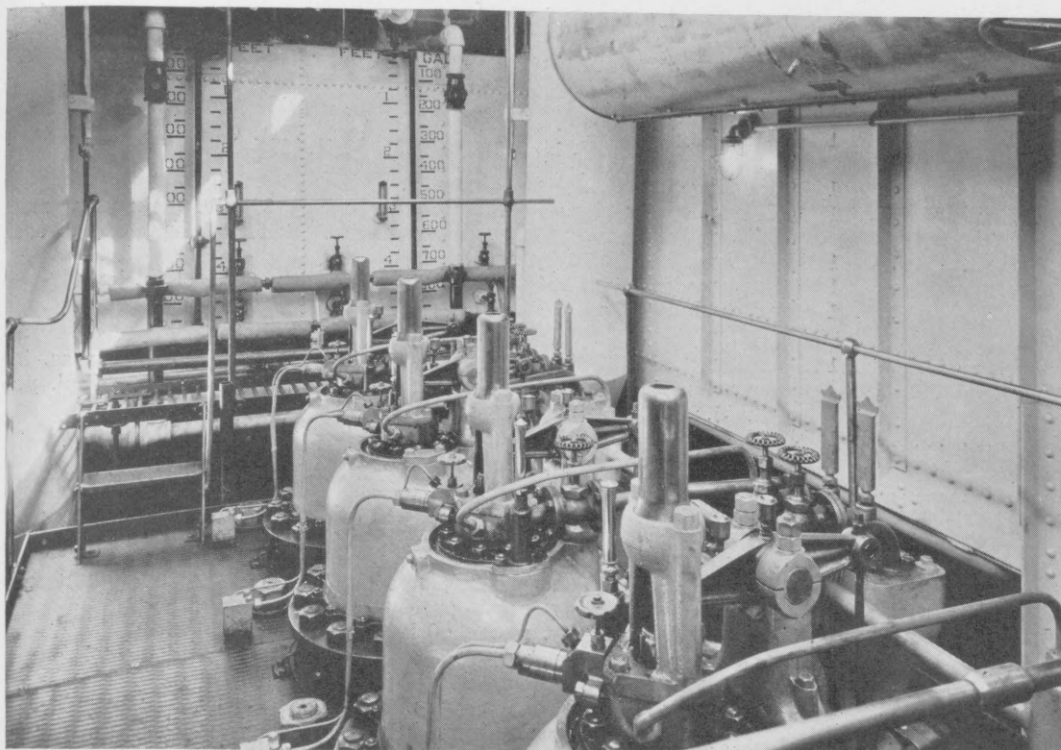
The jacket surface of the steel cylinder is corrugated to intensify cooling, which is further increased by the introduction of water through the central block. Flowing through the passages in the block the water enters drilled holes in the inner ends



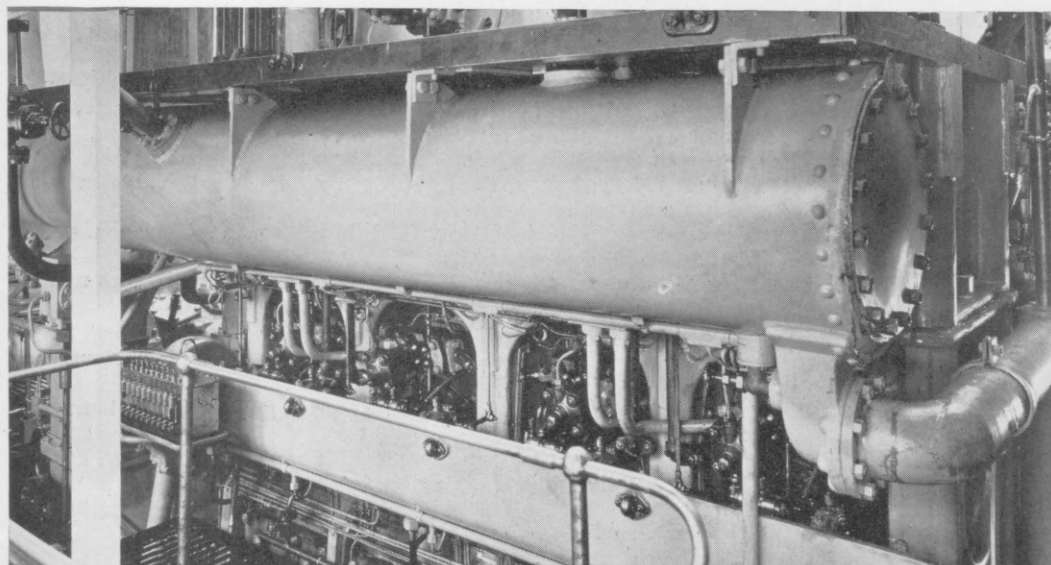
Auxiliaries on the starboard side include circulating pumps and a lubricating oil purifier



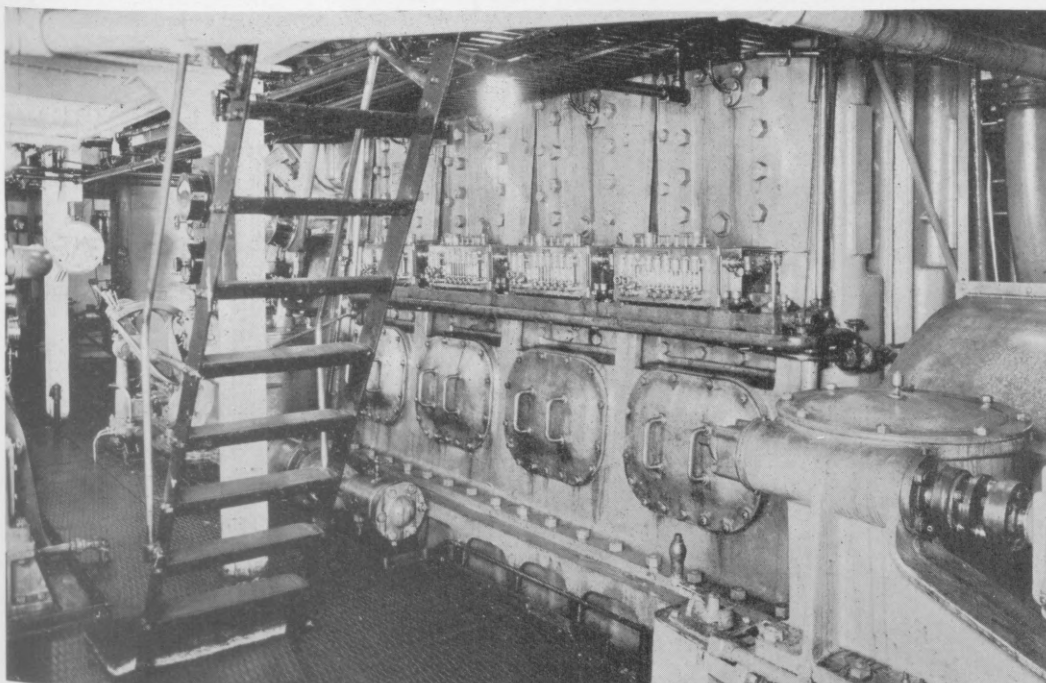
Double acting 2-cycle Diesel for Ms. Steel Chemist's main propulsion has scavage pump and 3-stage injection air compressor at forward end



Main engine cylinder tops looking from aft



Centre platform with exhaust manifold on port side



Lower platform showing controls at forward end

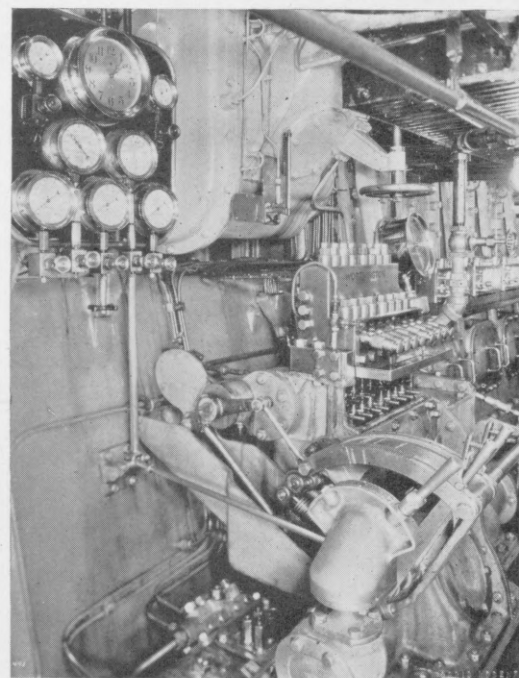
of the liners. Retarders consisting of steel rods in the holes increase the water velocity to about 3 ft. per sec., resulting in a high rate of heat transfer from the liner and steel cylinder. After passing through these holes, the water flows along the space between the jacket cover and the steel cylinder, the amount of water being regulated by valves at the outlets from the cylinder ends.

The piston is composed of five parts. The two end sections exposed to the heat of combustion are of alloy steel and between them are placed two cast iron bodies which hold the piston rings. This makes four parts fastened to the piston rod and in the space between the two assemblies are clamped the two halves of a cylindrical central section held together by keyed bolts.

The piston rod is hollow provided with a central tube to convey cooling water to the piston head, the return being made through the space between the tube and the wall of the rod. Water reaches the rod by means of telescopic tubes leading to passages in the crosshead.

The stuffing boxes of these tubes are arranged outside the crankcase enclosure, thus eliminating the danger of cooling water mixing with lubricating oil in the crankpits.

Fuel valves are of needle valve type with atomizing discs. Oil is introduced above the discs by a governor-controlled pump and when the needle valve is raised by the cam and rocker arm injection air forces the fuel into the cylinder in the form of a spray. The top fuel valve is arranged along the cylinder axis resting in a forged cover plate which seals the opening in the top cylinder end and to which also is bolted the light outer cooling jacket cover. The only part of the fuel valve exposed to the heat of combustion is the comparatively small tip, the rest being surrounded by the water cooled cover. Fuel for the lower combustion space is supplied by two valves, since owing to the piston rod, a single spray valve cannot be placed in the center. These two valves are in an inclined position; each tip has two holes so placed that fuel does not strike the piston rod itself



Control position

Details of Machinery Equipment of Lake Freighter Steel Chemist, 250 ft. b.p., 2077 tons d.w.c., 950 b.hp.

ITEM No.	NAME	MAKE	CHARACTERISTICS
PROPELLING MACHINERY DIRECT			
1	Main engine	Worthington	1 4-cyl., air injection, double acting, 16 in. x 24 in., 165 r.p.m., 950 b.hp.
2	Propeller	Federal	1 Solid mang. bronze, 9 ft. 6 in. diameter x 7 ft. 0 in. pitch, 4 blades, pitch ratio 0.736.
3	Propeller shaft	Federal	1 Solid forged steel, 9½ in. diameter.
4	Thrust bearing		1 Single collar, 2 shoe, 21 in. diameter collar, 316 lb. per sq. in. max thrust pressure, 26,800 lb. max. thrust. Steady bearing at one end.
5	Thrust shaft	Federal	1 Solid forged steel 10 in. diameter.
6	Stern tube	Federal	1 One piece cast iron, 16½ in. outside diameter x 6 ft. 11 in. long.
7	Contra-propeller	Federal	1 Star, 4 bladed, 6 ft. 6 in. diameter.
COMPRESSORS			
8	Main engine injection	Worthington	1 3-stage attached, 18½ in.-16¾ in.-4¼ in. x 18 in., 800 lb. per sq. in. working pressure, 328 cu. ft. free air, 438 cu. ft. piston displ. per min.
9	Main engine scavenging	Worthington	1 Tandem, 27 in. x 12 in., 1½ lb. per sq. in., 330 r.p.m., 5095 cu. ft. free air, 5052 cu. ft. piston displacement per min.
10	Maneuvering	Worthington	2 3-stage, 11½ in.-9¾ in.-2¾ in. x 6 in., 800 lb. per sq. in. working pressure, 90 cu. ft. free air, 120 cu. ft. piston displ. per min., driven by generator engine through Cutler Hammer magnetic clutch.
11	Emergency	Worthington	1 2-stage, 4½ in.-4 in. x 3½ in., 800 lb. per sq. in. working pressure, 10 cu. ft. free air, 133 cu. ft. piston displ. per min., 400 r.p.m., steam driven.
PUMPS			
12	F. w. circ.—sea	Worthington	1 Centrifugal 2-in.-20 hp. motor, 80 lb. per sq. in., 225 g.p.m.
13	S. w. circ.—sea	Worthington	1 Centrifugal 4 in.-15 hp. motor, 30 lb. per sq. in., 400 g.p.m.
14	S. w. circ.—port	Worthington	1 Centrifugal 2-in.-5 hp. motor, 30 lb. per sq. in., 150 g.p.m.
15	Fire and general service	Worthington	1 Centrifugal, 2-stage, 3 in.-25 hp. motor, 65 lb. per sq. in. ballast, 300 g.p.m., 100 lb. per sq. in. fire, 200 g.p.m.
16	Lub. oil	Worthington	1 Rotary, 2 in., 5 hp. motor, 40-lb. per sq. in., 60 g.p.m., for main engine only.
17	Lub. oil standby and transfer	Worthington	1 Vert. simplex, 6½ in.-7 in. x 8 in., 40 lb. per sq. in., 50 g.p.m., steam or air.
18	Fuel oil transfer	Worthington	1 Vert. simplex, 6½ in.-7 in. x 8 in., 75 lb. per sq. in., 60 g.p.m., steam or air.
19	Bilge and emergency fuel oil transfer	Worthington	1 Vert. Simplex, 6½ in.-7 in. x 8 in., 75 lb. per sq. in., 90 g.p.m., steam or air.
20	Distilled water	Worthington	1 Horiz. duplex, 3 in.-2 in. x 3 in., 40 lb. per sq. in., 9 g.p.m., steam or air.
21	Hot water circ.	Worthington	1 Horiz. duplex, 3 in.-2 in. x 3 in., 40 lb. per sq. in., 9 g.p.m., steam or air, with air chamber.
22	Donkey boiler feed	Worthington	2 Vert. simplex, 4 in.-2½ in. x 4 in., 150 lb. per sq. in., 4¼ g.p.m. each.
23	Injector	Metropolitan	1 125 lb. per sq. in. steam pressure, 1500 lb. water per hour.
24	F. w. circ.—auxiliary eng.	Worthington	1 Centrifugal, 2 in.-3 hp. motor, 30 lb. per sq. in., 50 g.p.m., port use.
HEATERS AND COOLERS			
25	Donkey boiler	Federal	1 Vert. fire tube, oil burning, 5 ft. 3 in. diameter x 9 ft. 0 in. high, 355 sq. ft. total heating surface, 125 lb. per sq. in. working pressure.
26	Condenser	Federal	1 Cylindrical, surface, 75 sq. ft. cooling surface.
30	H. w. storage heater	Federal	1 Coil, 25 lb. per sq. in. working pressure, 85 gal capacity, thermostat control.
31	Drinking water set	Griscom Russell	1 Coil, 25 lb. per sq. in. working pressure, 600 gal. per day.
32	Lub. oil cooler	Griscom Russell	1 Multiwhirl, 50 g.p.m. oil, 63 g.p.m. water.
33	F. w. cooler	Andale	1 Conterflow straight tube, 400 sq. ft. cooling surface, 204 g.p.m. f.w., 306 g.p.m. s.w.
ELECTRICAL EQUIPMENT			
34	Generator engines	Worthington	2 4-cyl., solid injection, single acting, 10¼ in. x 10½ in., 375 r.p.m., 125 b.hp., drive also maneuvering compressor through magnetic clutch.
35	Generators	Diehl	2 60 kw., direct current, 230 volt, 375 r.p.m., each direct connected to one engine.
36	Aux. generator set	Hill-Diehl	1 5 kw., direct current, 115 volt, 500-550 r.p.m.
37	Motor generator set	Diehl	1 7½ kw., direct current, 115 volt, motor 230 volt, for lighting circuit.
38	Helm indicator	Hyde	1 Shows 40 deg. each side of center.
39	Whistle control	Signal & Control Co.	1 For one air whistle.
40	Switchboard	Westinghouse	1 Marine, slate.
41	Radio outfit	R. C. A.	1 Tube, 200 watt.
42	Storage battery	Phil. Storage Battery Co. ..	1 Lead plate, 60 cell, 98 amp. hour.
HULL AUXILIARIES			
43	Cargo cranes	Brownhoist	2 3-motor, revolving, 65 hp., 25 hp., 15 hp. motors, Cutler Hammer control, 5 tons at 130 ft. per min., 50 ft. radius.
44	Steering gear	Hyde	1 Hydro-electric, 7 in. diameter rudder stock, 6 hp. motor, 7 in. diameter rams, Waterbury Tool Co. pump.
45	Warping winches	Hyde	4 Single geared, 15 hp. motor, 5000 lb. pull.
46	Windlass	Hyde	1 Spur geared, 35 hp. motor, handles two 3820 lb. anchors each with 30 fathoms of 1½ in. cable at 25 ft. per min.
47	Ice machine	Brunswick-Diehl	1 Ammonia, ½ ton per day, 2 hp. motor, Cutler Hammer control.
TANKS			
48	Injection air flasks	Worthington	2 Seamless steel, 18 in. diameter x 6 ft. 0 in. long, 1000 lb. per sq. in. working pressure.
49	Maneuvering air flasks	National Tube	4 Seamless steel, 18 in. diameter x 11 ft. 0 in. long, 1000 lb. per sq. in. working pressure, capacity for 18 starts of main engine.
50	Maneuvering air tank	Federal	1 Riveted steel, 4 ft. 0 in. diameter x 10 ft. 0 in. long, 350 lb. per sq. in. working pressure, capacity for 18 starts of main engine with flasks.
51	Whistle air	Federal	1 Lapweld steel, 22 in. diameter x 4 ft. 0 in. long, 125 lb. per sq. in. working pressure, 10 cu. ft. capacity.
52	Lub. oil drain tank—main engine ..	Federal	1 Welded steel, 175 gal. capacity.
53	Lub. oil settling	Federal	1 Welded steel, 190 gal. capacity, heating coils 6 sq. ft. surface.
54	Lub. oil storage	Federal	1 Welded steel, 360 gal. capacity, 30 days' supply.

Details of Machinery Equipment of Lake Freighter Steel Chemist, 250 ft. b.p., 2,077 tons d.w.c., 950 b.hp.—Contd.

ITEM No.	NAME	MAKE	CHARACTERISTICS
55	Fuel tank, daily service	Federal	1 Riveted steel, 6 tons capacity, 25 hours' supply, heating coils 27 sq. ft. surface.
56	Fresh water	Federal	1 Riveted steel, 300 gal.
MISCELLANEOUS			
57	Main engine muffler	Maxim	1 18 in. diameter connection.
58	Aux. engines mufflers	Maxim	2 8 in. diameter connection.
59	Scavenge pump intake muffler.....	Worthington	1 16 in. diameter connection.
60	Lub. oil purifier	De Laval	1 100 g.p.m.
61	Fuel oil burner	Todd	1 Rotary, gravity feed, forced draft.
62	Air whistler	Typhon	2 125 lb. per sq. in. working pressure, steam or air.
63	Engine room telegraph	Cory	1 Mechanical, single reply.
64	Exhaust gas pyrometer	Brown	1 Thermocouple electric, 15 point selector switch, thermocouple at four main and eight auxiliary engine exhaust ports.
65	Boiler safety valve	Star Brass	1 Single relief 2 in., 125 lb. per sq. in. working pressure.
66	Reducing valve—heating system....	Leslie	1 Spring loaded 1½ in.
67	Drill press	Hammacher Schlemmer ..	1 Hand driven.
68	Emery grinder	Hisey Wolf	1 Motor driven, two 10 in. x 1½ in. wheels.
69	Gyro equipment	Sperry	1 Compass, and automatic steering.

but passes alongside of it, there being thus four fuel sprays. The valve bodies in the bottom combustion space are equipped with a sleeve into which oil is introduced tangentially and the resultant turbulence maintains the presence of oil around the tips. This overcomes the tendency of the oil to flow downward and away from the tip. The fuel valves for the bottom combustion space are actuated through rockers and push rods by cams placed on a camshaft running along the engine above the frame. This camshaft also operates the push rods of the rocker arms of the fuel valves for the top combustion space.

Reversal of the valve timing gear is carried out by displacement of helical gears between the crankshaft and camshaft. The fuel pump is also driven by the same helical gear train and the timing of the pump plungers therefore altered to

conform with the desired direction of running. The fuel pump consists of a steel body provided with a plunger for each cylinder end. The amount of fuel delivered is controlled by lever action which regulates the timing of the pump suction valves. An overspeed governor is also part of this mechanism.

The scavenge pump is driven off an extension of the crankshaft at the forward end being between the engine and the injection air compressor. The injection air compressor is of 3-stage type, of which the first stage is double acting. Each stage discharges its air into a straight tube cooler.

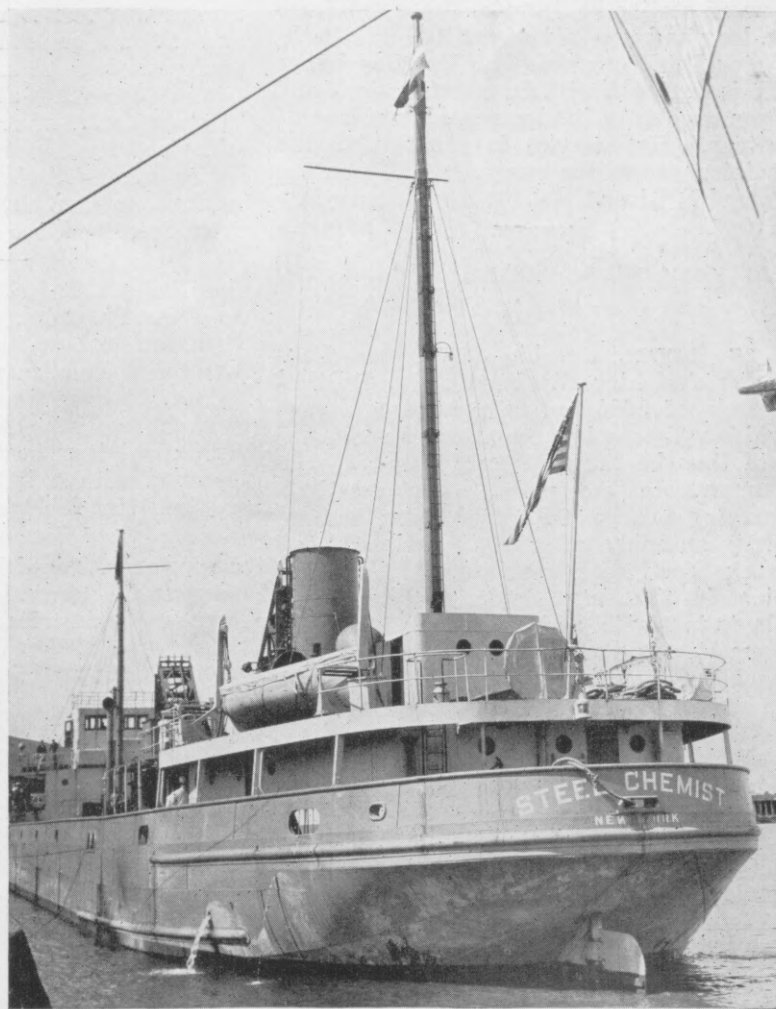
The center block of each main cylinder is supported on a distance piece or box resting on independent cast iron box frames, which in turn rest on the engine bedplate. Each frame is flanged to the adjoining frame to form a common crank-

case for the power cylinders and compressor but the frames are only tied in on the bottom, permitting easy expansion of each vertical element. Cylinders are held by means of four tie rods placed at each corner of the cylinder center block and passing through the distance piece, the frame members and the bedplate. The rods take up the tension stresses resulting from combustion in the upper ends of the cylinders, the compressive stresses in the frame caused by the lower cylinder ends being taken up by cast iron members. The frames carry the support for the crosshead guides, which are of flat water cooled type with stern bars to support the crosshead shoes with the engines running astern.

The crankshaft is built up of sections drilled to provide the supply of lubricating oil under pressure to the journals, crankpins and crosshead pins.



Two 3-ton cranes handle all cargo



Engineers are quartered in a house aft

STRECKFUS Steamship Line of St. Louis, Mo., are to construct a large side wheel excursion steamer to be propelled by Diesel electric machinery. When completed this ship will be unique on inland waterways. In fact, she will be one of the few Diesel-electric side wheel packet ships, if not the only one in the world.

Inland Waterways Corp. has taken over from the W. C. Kelly Barge Line its Diesel driven tunnel stern towboat **GEORGE T. PRICE** and a fleet of barges which are planned to be used in the Memphis-St. Louis River service. W. C. Kelly Barge Line was a private enterprise owned by the controlling interests of the Kelly Axe & Tool Co., Charleston, W. Va. There has been no direct connection between the two companies and Kelly Axe & Tool Co. is still using the inland waterways for transporting its raw material and shipping finished products as heretofore.

GEORGE T. PRICE was described in detail in **MOTORSHIP** for August, 1926. She is one of the most efficient Diesel powered towboats in operation on the Western Rivers and the Charles Ward Engineering Works, Charleston, W. Va., is at present at work on the construction of two duplicates. The Ward Company has received also a contract from the W. C. Kelly Barge Line, which is having the tugs built, for building nine covered barges of 150 ft. length. When this constructional work is finished W. C. Kelly Line will be the owners of four towboats and 18 barges.

LARCH, the new Diesel engined lighthouse tender for the Columbia River district, is now on station at Astoria, Ore. She is 65 ft. long and powered with a 100 hp. Washington-Estep engine. For handling buoys she is equipped with an electric winch and boom capable of lifting a maximum load of 3 tons. Her service is confined to the maintenance of the navigation aids on the Columbia River.

East Indian's Round the World Cruise

EAST INDIAN, the big 12,500 ton Ford motor freighter fitted with Sun-Doxford Diesels of 5000 hp. is now on a voyage which will take her round the world. She will thus be the first Ford vessel to circumnavigate the globe. The vessel is carrying a cargo of Ford parts for the complete assembly of 2500 Ford cars and trucks destined for delivery to the Ford plant in Yokohama, Japan, and to service plants in Manila and Shanghai. She sailed from New York and her first ports of call were in Cuba where she took on in addition to her automobile cargo, 7000 tons of sugar for delivery at Takao, Formosa.

After discharging her cargo in the far eastern ports mentioned **EAST INDIAN** will follow the practice, generally carried out by Ford ships, of delivering finished products and returning with raw materials to be manufactured into more Ford products. She will return by way of Suez Canal and the Mediterranean, loading tin and rubber at Singapore and antimony from Shanghai. The vessel is expected to reach New York again about the middle of November.

Motorship

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Readers are invited by the Editor to submit articles, photographs or drawings relating to motorships, marine oil-engines or auxiliaries. Contributions used in the magazine are paid for on the 15th of the title month of issue, and other contributions are returned as promptly as possible.

Golden Gate Ferry Company of San Francisco has asked for bids on 1, 2, 3, 4 or 5 Diesel-electric ferries similar to **GOLDEN STATE** described in August **MOTORSHIP**. The ferries will be 240 ft. overall, 44 ft. beam and 17 ft. molded depth and will be equipped with three 6-cylinder, 400 b.hp. Diesels operating at 265 r.p.m. connected to generators. The number of ferries to be constructed will probably depend upon the action of the State Railroad Commission relative to the automobile ferry service from San Francisco to Alameda.

San Diego, Cal., has its first Diesel engined tug, the **PALOMAR**, owned by the Star & Crescent Boat Co., of that city. **PALOMAR** has the distinction also of being the only privately owned towboat in San Diego harbor, the other towboats being Navy tugs. The new Diesel boat is 85 ft. long and is powered with a 240 hp. Fairbanks-Morse engine. Her fuel tank capacity is 6000 gal.

Bids were received by the Union Oil Company of California in Los Angeles, for the new tanker described in September **MOTORSHIP**. The lowest prices quoted by three of the leading Pacific Coast shipyards, are as follow:

Los Angeles Sb. Corp.	\$233,340
Moore Drydock Co.	\$256,567
Bethlehem Sb. Corp.	\$291,000

Western Machinery Co. were the lowest bidders on the Diesel engines for this tanker. No award has been made as yet.

Converted from steam and thoroughly reconditioned the old tug **SOUND**, owned by the Gilkey Tug Co. of Bellingham, Wash., enters on a new lease of usefulness with a 270 hp. Washington-Estep engine.

Clipping previous records by several days, Prince line ms. **JAPANESE PRINCE** recently made the voyage from New York to Yokohama, via Norfolk, the Panama Canal, and Los Angeles in just under 33 days elapsed time. She and her sisters, which have equally good performances to their credit, are thus establishing records for the fast transportation of merchandise to the Far East.

JAPANESE PRINCE is one of five new motor vessels of the Prince Line Far Eastern service and has a net tonnage of 6,152. On this voyage she passed through the Panama Canal on June 20 laden with 5,850 tons of general cargo. It is possible that the new Prince Liners will make the voyage from New York to Yokohama in 28 days when their machinery is thoroughly adjusted.

Motorships and the Suez Canal

Motorship traffic through the Suez Canal has more than doubled since 1922. Compared with 1924, last year's figures showed an increase of 58 per cent, amounting to 1,720,000 net tons as against 1,089,000 net tons. This increase represents 38 per cent of the total increase of the canal traffic for the year. The number of motorships last year was 118 and the number of transits 324, as compared with 91 motorships and 235 transits in 1924. No motortankers had passed through the canal 5 years ago. The total in 1925 was 12. Last year 51 new motorships made their appearance in the canal for the first time, as compared with 39 in 1924. In the total number of ships "new" to the canal, out of each one hundred vessels there were six motorships in 1922, five in 1923, twelve in 1924, and thirteen in 1925.

Largest Diesel-Electric Tugs

Panama Canal Commission has awarded a contract to the Ingersoll-Rand Co. for four 6-cylinder, 480 hp. Diesels to be installed in two Diesel-electric tugs which are soon to be built at the Balboa shops for service on the Panama Canal, and which, when constructed, will have an overall length of 150 ft., thus being the largest and most powerful Diesel-electric tugs so far under construction anywhere in the world. One of these will be assigned to the Marine Division on the Pacific Coast for towing large vessels into and out of the entrance to the Canal. The other will be used by the Dredging Division for dredging operations in the various parts of the Canal.

Pilot house control on the Ward-Leonard system will be installed and the engines will drive generators and exciters, for which tenders are now being asked by the General Purchasing Officer of the Panama Canal. The generators are to furnish current for a main propulsion motor of 750 s.h.p. at approximately 115 r.p.m. In conjunction with these motors and exciters tenders are also being asked for a combination generator and compressor set, the generator being of 10 kw. capacity, and one hydro-electric steering gear, an air compressor and a direct connected single stage centrifugal fire pump. There will also be a motor driven fuel oil transfer pump and two other motor-driven rotary pumps having a capacity of 250 gal. per min. each.

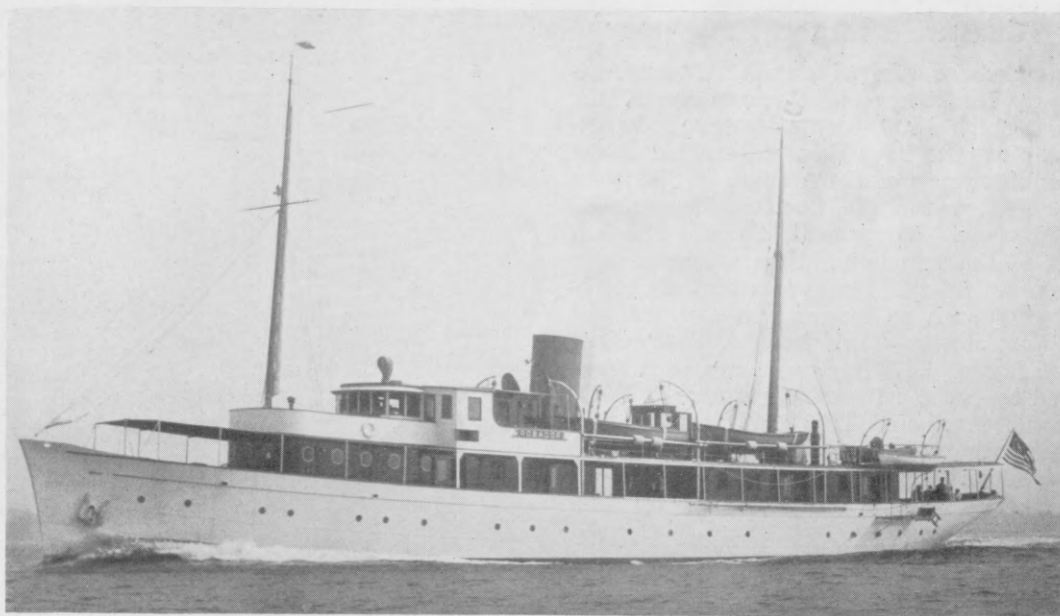
Motoryacht Robador

ROBADOR, 161 ft. motoryacht, has recently been delivered by her builders, Newport News Sb. & Dry Dock Company to Commodore Robert Law of the Indian Harbor Yacht Club, and is now cruising in eastern waters. ROBADOR's power plant consists of two 450 hp. Winton Diesels which give her a speed of about 15 knots on service. On her delivery trip from Newport News, made in heavy weather, ROBADOR demonstrated the fact that she was an admirable sea boat. Cox & Stevens, New York, designed the vessel.

Motoryacht Arcadia

ARCADIA, 188 ft. Diesel yacht completed recently by the Newport News Sb. Co. for Galen L. Stone of Boston, has two 800 b.hp. Winton Diesels of new design, described elsewhere in this issue. Before leaving her builders' yard the vessel ran a series of trials and demonstrated her ability to make a speed of over 16 knots. At this speed, and, indeed, at all speeds, there was very little vibration.

ARCADIA has a length overall of 188 ft., a length on waterline of 177 ft., beam

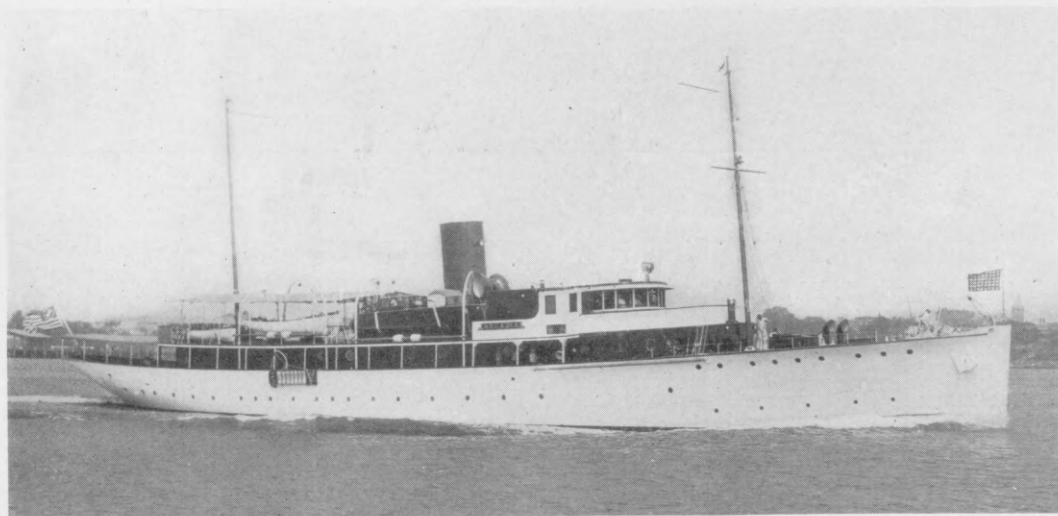


Motoryacht Robador has a slightly curved stem and a raking counter

machinery space contains two Winton Diesels of 800 hp. each. The auxiliaries comprise two Diesel generators of 35 kw. capacity, the usual service pumps and electric

Pacific Coast Yacht

MALIBU, the new 100 ft. boat for Mrs. M. K. Rindge and Mrs. M. H. Adamson of Riverside, Cal., is the second Diesel engined yacht completed on the West Coast this year. Like nearly all the power yachts of these later days MALIBU has a straight stem with the counter stern, but the West Coast influence shows itself in a pronounced sheer and in the marked flare. Below deck, the guest accommodation consists of five staterooms—two double and three single—with separate toilets, two tub baths and a shower bath. The owners' stateroom is a large double room on deck amidships with adjoining bathroom. Aft that is the large dining and living room; forward of it is the galley—which is also the crew's mess-room—the captain's cabin and the wheelhouse. An exhaust fan on the boat deck assists ventilation of the living quarters when the boat is in tropical waters. For propulsion MALIBU has two 120 hp. Washington-Estep airless injection engines fitted with Berger air-clutch controls operated from the wheelhouse. Electric current for the auxiliaries and lighting is furnished by two Fairbanks, Morse 2½ kw. generators when the boat is under way, these dynamos being belted to the main engine shafts. At night the current is taken from a storage battery.



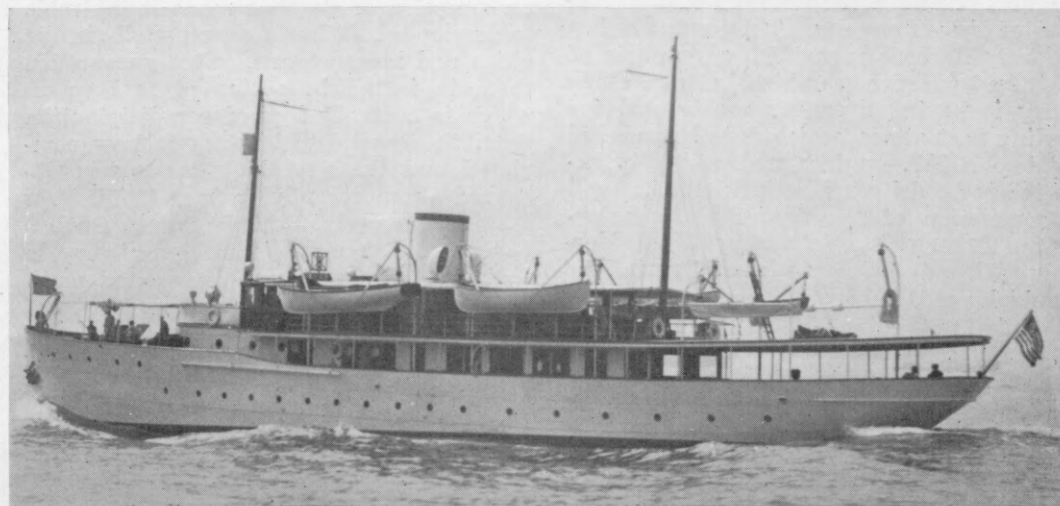
Arcadia's stem is straight, her stack oval and slightly raked

molded of 27 ft. 6 in., draft of 11 ft. The general type of design is that adopted in many recent seagoing yachts of Cox & Stevens design. There is continuous sheer, high bulwarks and moderate overhang aft, terminating in a well-modeled transom. The

refrigerating plant, hot water heating plant, with radiators in all living spaces, a forced ventilation system operated by electricity, and electric boat hoists, deck winches and anchor handling gear. Fuel oil tanks are provided for 9000 miles.

Motoryacht Sumar

Powered by two 420 hp. Bessemer Diesels which give her a speed of 14 knots, David C. Witney's Gielow-designed motoryacht SUMAR is now cruising on the Great Lakes. She has a length overall of 160 ft., a length on waterline of 152 ft. 6 in., a beam molded of 26 ft. and a depth molded of 12 ft. 0 in. The owner plans to make a cruise through the Mediterranean in the fall, returning to home waters in the spring of 1927, when he will leave immediately for a South American cruise which will bring him back into American waters about the middle of 1928. For this extensive ocean work SUMAR is particularly well suited. She has a strong seaworthy hull and her navigating equipment, which is of the most up to date type, includes a Sperry gyro compass and automatic steering device.



Sumar's deckhouse and squat stack give her an appearance of strength

Coastwise Motor Freighter

Intended for coastwise runs between Antwerp, Dunkirk and Moroccan ports, the motorships PAUL-EMILE-JAVARY and ANDRE-MOYRAND have been constructed at the Dunkirk yards of the Ateliers et Chantiers de France for the Société Anonyme de Gérance et d'Armement, Paris. The layout of the vessels has been arranged with a view to the transportation of heavy cargoes such as locomotives and railroad rolling stock. They have a deadweight capacity of 3575 tons and are each powered by one 6-cylinder Burmeister & Wain engine developing 1350 i.hp. at 120 r.p.m. giving the ship a service speed of about 9½ knots. The auxiliary machinery is all electrically operated and current for this purpose is supplied by three B. & W. 33 kw. auxiliary generators. All propelling and auxiliary machinery was constructed at Burmeister & Wain works, Copenhagen. The vessels are of three island type with a partial 'tween deck in the forward and aft holds. There are four cargo holds, two forward and two abaft the machinery space. Each hatchway has two 5-ton derricks and Nos. 2 and 3 holds have, in addition a 25-ton derrick, all operated in conjunction with Laurence Scott type electric winches.

French Motorship Construction

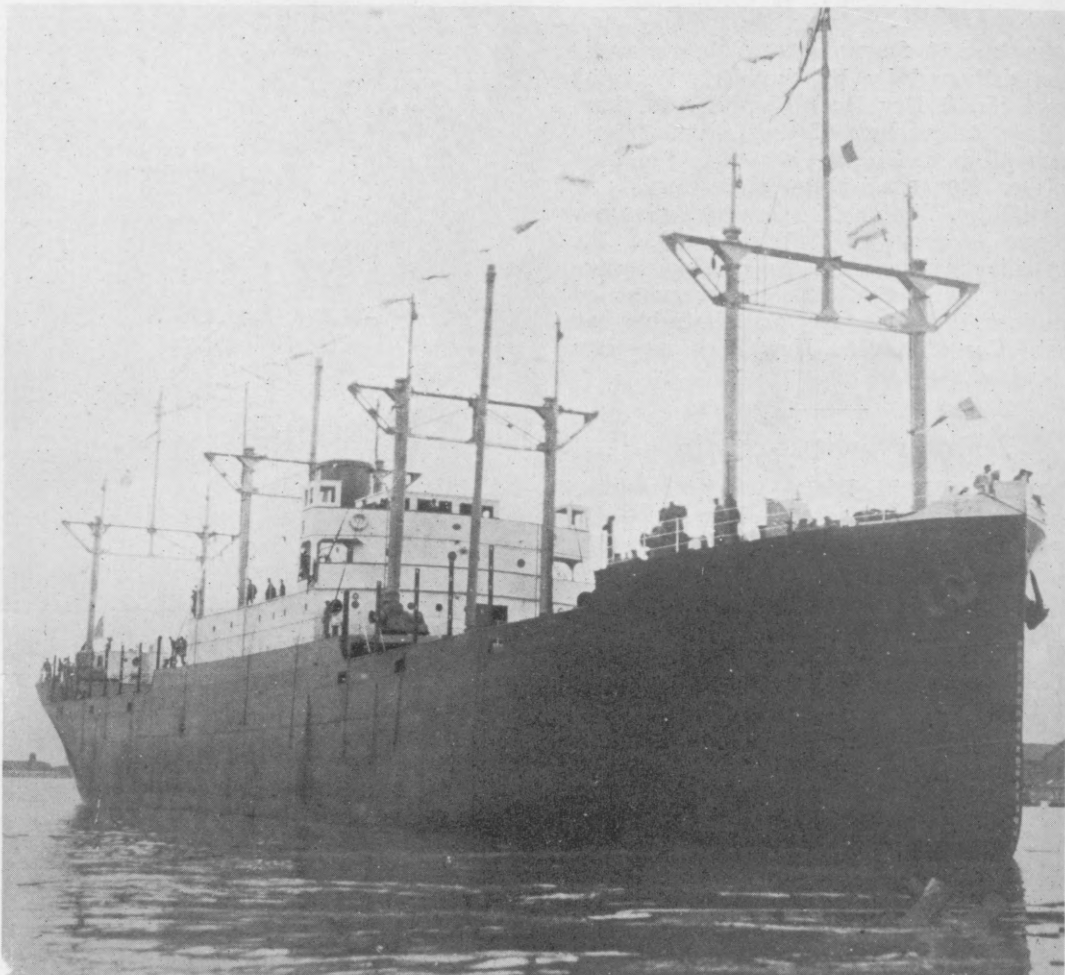
A total of 13 motorships is now under construction or completing in French shipyards. This includes four tankers of large size, three of which are being constructed for foreign owners. Two motortankers now under construction at the Chantiers Navals Français for the Soviet Government will have a deadweight capacity of 10,900 tons. They are to be constructed on the Miller combination longitudinal and transverse system of construction and will have their forward ends especially strengthened for navigation in ice. They will be powered by two 4-cylinder Sulzer engines developing 2500 b. hp. per ship, giving a speed (loaded) of 11 knots. These engines are all to be constructed in France.

An order which has aroused considerable interest is that for a 10,500 tons d.w. tanker for a Bergen owner, which is being built at Rouen. This vessel is to be powered by an 8-cylinder B.&W. engine developing 4250 hp. at 110 r.p.m., and the order for the construction of the engine has been placed with the Schneider Company, who comparatively recently bought a license for the construction of B.&W. engines. This company has so far only constructed Diesel engines of its own type for warships. The French Navy is having a tanker constructed for fueling fleet at sea, which is to be powered by two B.&W. engines and which is expected to be delivered early in 1927.

Completion of the first French motorliner THEOPHILE GAUTIER was considerably delayed owing to a strike in the Dunkirk yards, where she was completed.

While the construction of Diesel engines is being stimulated in France by foreign and naval orders, French shipowners are still somewhat tardy in adopting this type of machinery.

ATLANTIC, a 110 ft. fishing boat building in San Diego, Cal., for J. V. Soares and M. O. Medine, is driven by a 300 hp. Union Diesel.



Provision for heavy cargo is made on Coastwise Ms. Andre-Moyrand

South African Gasoline

Diesel electric ms. J. W. VAN DYKE is now running regularly in Atlantic Refining Co.'s bulk gasoline trade between this country and South Africa. Her recent arrival at Durban marked the commencement of her owner's activities in bulk (as opposed to case) transportation of gasoline for this trade and the step has been rendered necessary by the increasing demand for gasoline in South Africa.

Ordinarily South Africa is what is known as a "case" market. When the business was small, case transportation was quite efficient, and for the interior trade this method will probably continue to be the best method of distribution for years to come. After Atlantic's first year of experience in this market, however, the conclusion was reached that the increased consumption of gasoline made it desirable to develop a bulk business, especially in the cities and larger towns. This encouraged them to install bulk storage at Durban, which is centrally located for distribution from the coast. This plant is now completed and the first bulk cargo was delivered there recently in ms. J. W. VAN DYKE. The arrival of this ship in Durban harbor was an event in marine history in that part of the world, and excited much interest in electrical and marine circles.

Motorship's Economical Operation

Successful and economical performance is reported of the Atlas Diesels installed in the motorship DELHI owned by the Swedish East Asiatic Co., which has recently completed her first round trip to the Far East. DELHI has a deadweight capacity of 7600

tons and is propelled by two Atlas Diesels of 1650 i.hp. each, and three auxiliary Diesels of 100 hp. each, direct coupled to generators supplying current to the whole of the engineroom and deck auxiliary machinery. Loaded with a full cargo the ship made an average speed of 12.5 knots, developing 3262 i.hp., with an average fuel consumption per day of 10 tons. The total length voyage was 20,679 nautical miles, requiring 1865 hours at sea at full power, slow speed and maneuvering.

Wilh. Wilhelmsen Co., Oslo, has recently taken delivery of TOLEDO, another unit of their large motorship fleet, which, when all construction at present under way is completed, will comprise 23 units. TOLEDO is of three island type, with poop, bridge, and f'c'sle. She has five cargo holds, three forward of the machinery space and two abaft. No. 3 hold is also arranged as a deep tank. All the deck machinery is electrically driven. Propulsive power is furnished by a 6-cylinder B. & W. Diesel rated for 3000 hp. at 105 r.p.m. All auxiliary machinery is electrically driven, current at 220 volts being supplied by three 66-kw. Diesel generators. On trials, which took place recently in the Kattegat, the main engine developed 3046 i.hp. at 117.5 r.p.m., with a fuel consumption of 0.294 lb. per i.hp. hr. This consumption includes that of the auxiliary engines in operation for driving auxiliary machinery, electric steering gear and lighting.

Plans and specifications have been issued by Tidewater Oil Co., New York, for the construction of a twin screw Diesel barge. Bids were received at the office of B. H. Jones, Marine Manager, on Sept. 15.

Fairbanks, Morse Build Larger Diesels

Higher Powered Units Are Produced to Meet Present Demands of Marine Field

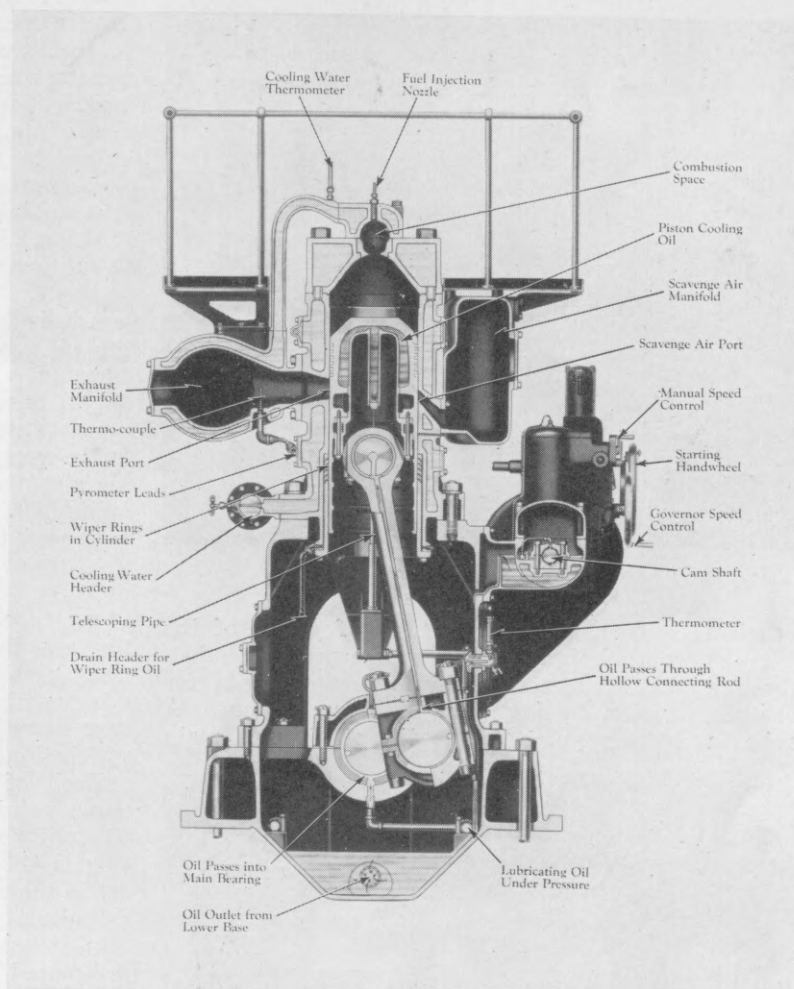
FAIRBANKS, MORSE & COMPANY is now constructing Diesel engines in ratings of 480, 600 and 720 hp. The engines are 2-cycle, port scavenging, airless injection type, and with these fundamental principles a number of noteworthy features have been incorporated such as two stage combustion, pressure lubrication throughout, reversible and centralized control, and a built in scavenging pump.

It has always been the policy of the Fairbanks, Morse organization to build engines in a range of ratings where demand would warrant large production facilities. With the rapidly growing use of Diesels in both the marine and stationary field there has come a greater demand for larger engines and the new ratings are the reply to that demand. Some twelve of the new 720 hp. units have already gone into service which shows that this larger series of engines will play an important part in increasing the output of a plant which for the past few years has been building engines at the rate of 200,000 hp. annually.

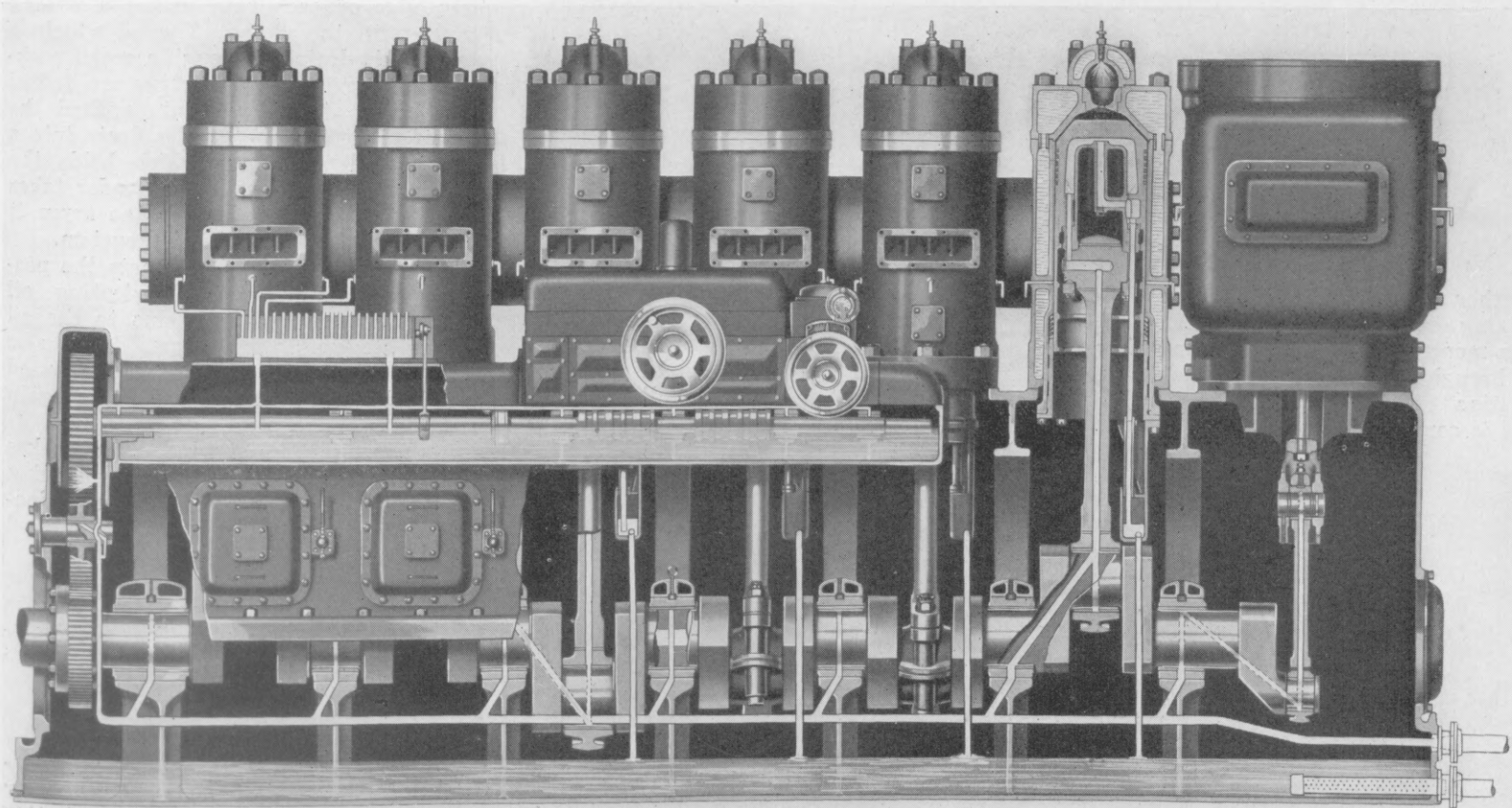
In the airless fuel injection system and two stage combustion principle which, in com-

mon with the smaller engines, the 480, 600, and 720 hp. F.M. engines use, fuel is sprayed into a combustion chamber located at the top of the cylinder. The timing of the injection is such that the flow of air from the cylinder up through the neck of the combustion chamber space meets the injected fuel, causing a considerable turbulence and an intimate mixture of the fuel and air. The velocity of the fuel from the injection nozzle at the top of the combustion chamber, and the velocity of the air entering from the cylinder into the combustion chamber are practically the same, so that the fuel is not blown back against the surface of the combustion chamber nor is the atomized fuel blown through the combustion chamber before combustion begins.

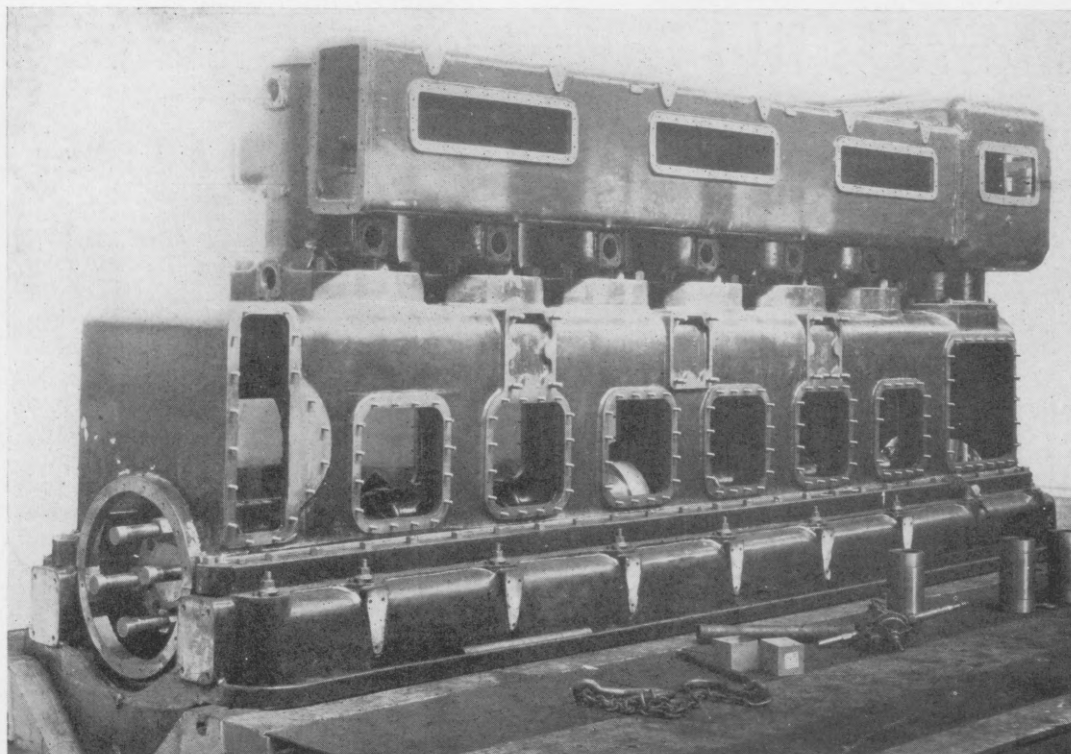
This intimate mingling of air and fuel takes place just at the instant of maximum compression—500 lb. per sq. in., and because the temperature at this compression is approximately 1000 deg. Fahr. the fuel charge ignites and slow combustion begins. Due to the fact that there is not sufficient oxygen in this combustion chamber for complete combus-



Transverse section through cylinder of 720 hp. F.M. engine



Diagrammatic representation of pressure lubrication and water cooling systems in large Fairbanks, Morse engines, now building

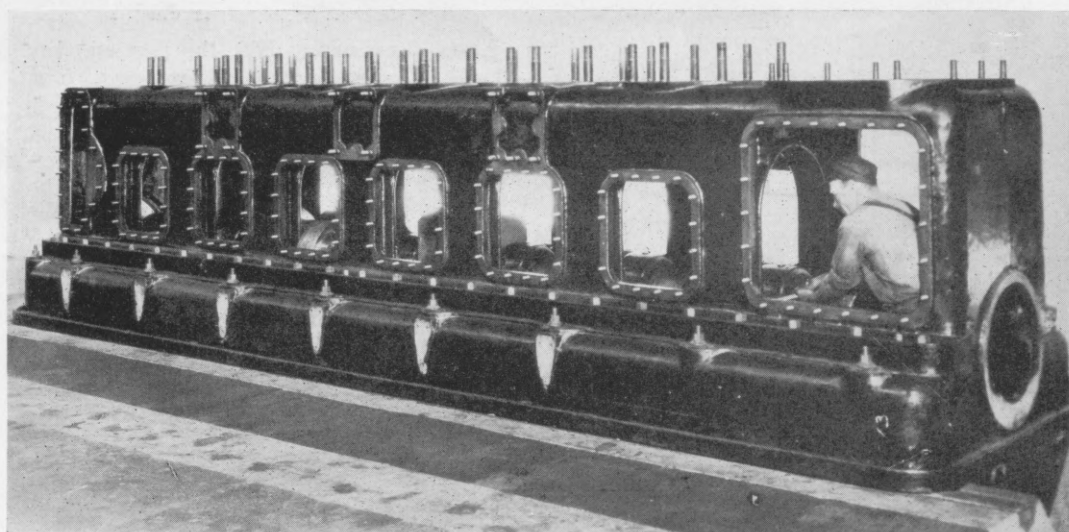


New Fairbanks, Morse engine with cylinder assembly in position

tion the fuel charge burns to carbon monoxide.

With the attendant rush of gases through the neck into the cylinder space, as the piston recedes on the downward stroke, a

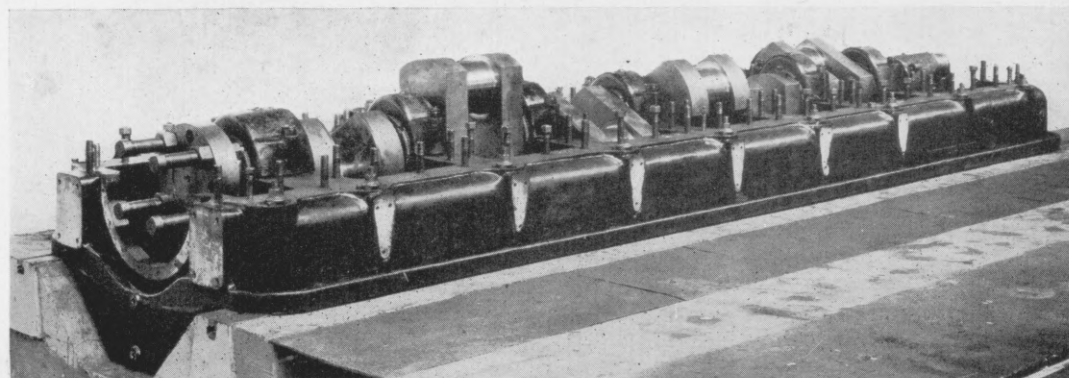
One of the outstanding features of the new design is the way the pressure lubricating system and the arrangements for piston cooling have been worked out. A rotary pump drains the oil from a main



Upper and lower base with crankshaft in position looking aft

further turbulence is created, a thorough mixing of the excess air with the carbon monoxide gas and remaining oil vapor is brought about, and then the final combustion of the charge to carbon dioxide gas is completed.

storage tank and forces it through a duplex strainer and then through a cooler into the header in the lower base of the engine. The oil enters the header under pressure and is distributed by branch lines to all main bearings. Circulation grooves in the



Lower base of engine with crankshaft in position looking forward

main bearings register with holes in the crankshaft permitting the major part of the oil to pass through the crankshaft to the crankpin bearings. In the same manner circulation grooves in the crankpin bearings register with the holes in the crankpin allowing the oil to flow continuously from pin to groove. These grooves in turn connect with holes in the upper half of the crankpin bearing and hollow connecting rod. A hole through the piston pin bearing permits the oil to enter the hollow piston pin.

Due to the proper clearances between crankshaft journals and bearings, crankpins and bearings, piston pins and bearings, sufficient oil is directed from the main flow to lubricate these surfaces amply and effectively.

A tube from the piston pin connects with the oil cooling space in the piston head, allowing a continuous entrance of cooled oil. A telescopic pipe from the cooled space connects with an oil outlet pocket situated in the upper part of the upper base affording a continuous outlet or discharge for the cooling oil. From this outlet pocket, the oil is passed through a thermometer well on the outside of the upper base affording the operator an opportunity to check the flow of oil through the system. After passing through the thermometer well the oil is discharged into the lower base where it mixes with the oil from the bearings and then flows into the main storage tank after which the cycle is repeated.

Each of the cylinders is lubricated at three points by a forced feed lubricator. The unique feature of the cylinder lubrication is the fact that four wiper rings are set in the cylinder. The lower part of each cylinder is bored out to a greater diameter than the piston. Then the four wiper rings are placed in this recessed portion and are held in place by a sleeve which is bolted to the bottom of the cylinder. The wiper rings are so constructed that the upper and lower edge of each ring makes a wiping contact with the piston. The oil which is wiped off is drained through a small pocket in the ring itself. The rings are drilled at an angle at twelve points around the circumference and these holes drain into a space behind the sleeve which holds the rings in place. A small pipe header takes this oil to a sump and from the sump it passes through the purification system.

These oil wiper rings eliminate the possibility of any loss of lubricating oil through the exhaust ports due to the oil working up past the piston. They also make it possible to purify the oil used for cylinder lubrication before it is again passed into the system.

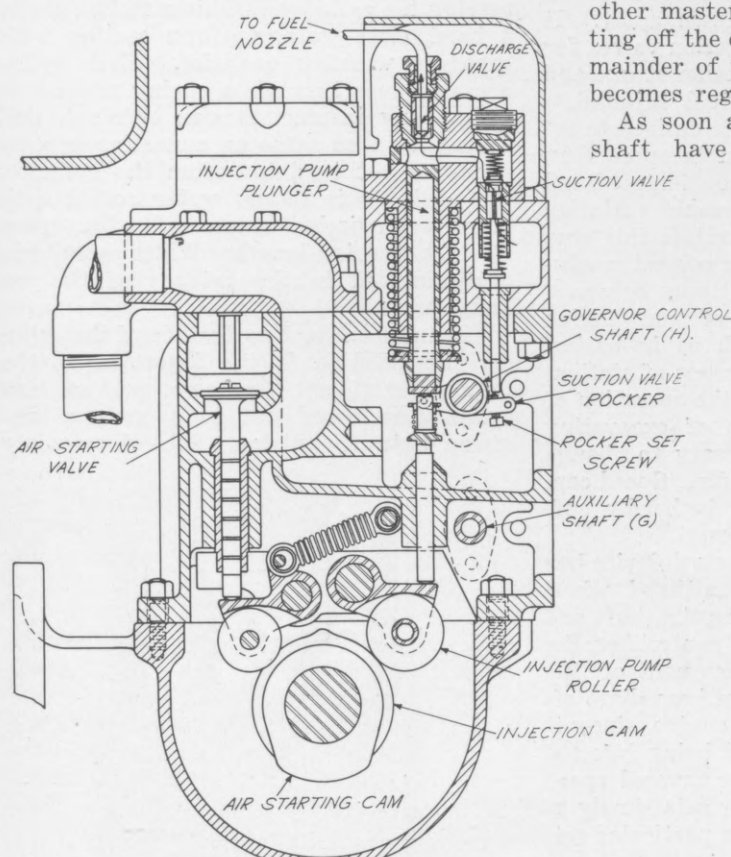
This arrangement of wiper rings makes it possible to secure the same lubricating oil economy and freedom from contamination similar to that secured in a crosshead construction.

No stuffing boxes are required and the construction is exceedingly simple. The only telescopic pipe used is that for draining the oil from the piston head back to the crankcase and there is no necessity for making this particular telescopic pipe a tight fit.

Complete control of the engine is centered in a compact unit located at the center of the engine and housing the injection pumps and air starting mechanism. The

governor unit with its hand wheel for speed control is mounted alongside the injection and air starting unit, thus centralizing the complete control system. The accompanying sectional diagram of the control unit and governor show clearly how the engine is operated.

The first step in starting the engine is to throw the control hand wheel to the "start" position. When the control hand wheel is turned it operates the engine control shaft through reduction gears. On this shaft are two cams which actuate two master air valves. One of the master valves connects with the passageway supplying starting air to the individual valves for the three forward cylinders and the other master valve supplies air to the individual units for the three after cylinders. The master air valves are double seated to obtain sufficient valve area without using a valve of large diameter. When these valves are open the flow of air is as indicated by the arrows.



Cross section through fuel pump and starting valve unit

When the hand wheel is rotated to the "start" position, both of the master valves are open and compressed air is admitted to the individual valves of all cylinders. These individual valves are cam operated and the air is then admitted to each cylinder at the proper time in the stroke of the piston for the particular direction of rotation which is desired.

At the time of the opening of the master air valve, a cam on the engine control shaft rotates an auxiliary shaft connected by means of a link to the governor control shaft. The governor control shaft rotates in eccentric bearings and thus controls the angular position of the suction valve rockers, and the position of the rockers in turn regulates the opening of the fuel suction valves. This auxiliary shaft, operated by the engine control shaft, thus regulates the position of the suction valves during starting and is so arranged that these valves close during starting, and fuel and starting

air are injected and admitted into the cylinders at the same time.

As soon as the engine is turned over on compressed air, the hand wheel is moved back to the second starting position. One of the cams operating the master valves closes, one of these valves shutting off the compressed air supply from three of the cylinders. The heat of compression in the cylinders ignites and burns the fuel in the three cylinders which are thus cut off from the compressed air. The impulse from these cylinders speeds up the engine and the hand wheel is then turned to the "run" position, closing the

other master air valve and thereby cutting off the compressed air from the remainder of the cylinders. Firing then becomes regular in all cylinders.

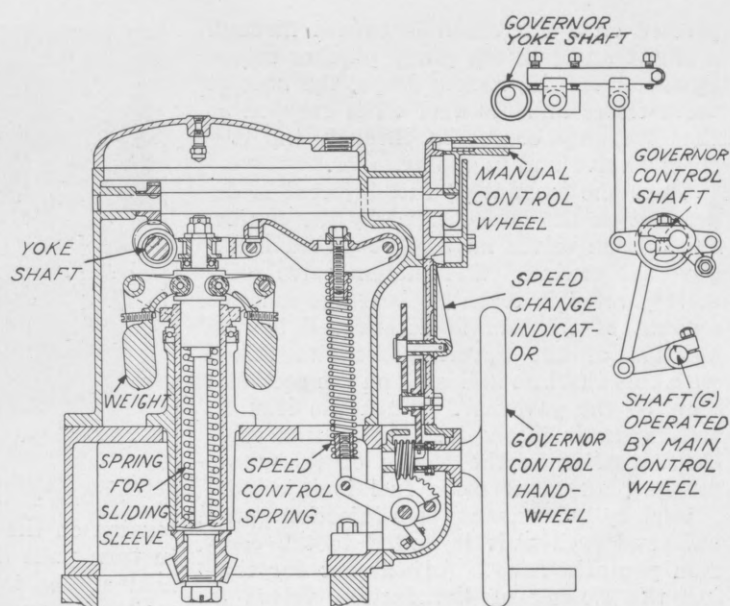
As soon as the cams on the control shaft have allowed the master air valves to close, the air pressure in the passages (M) supplying the individual valves, forces the lower push rods (N) to bleed out between the upper and lower push rods through the holes as indicated by the arrows. The air pressure above the individual valves is thus relieved and the springs lift the air start rockers up until they strike the stop.

The rockers and rollers from the individual valves to the cylinders are there-

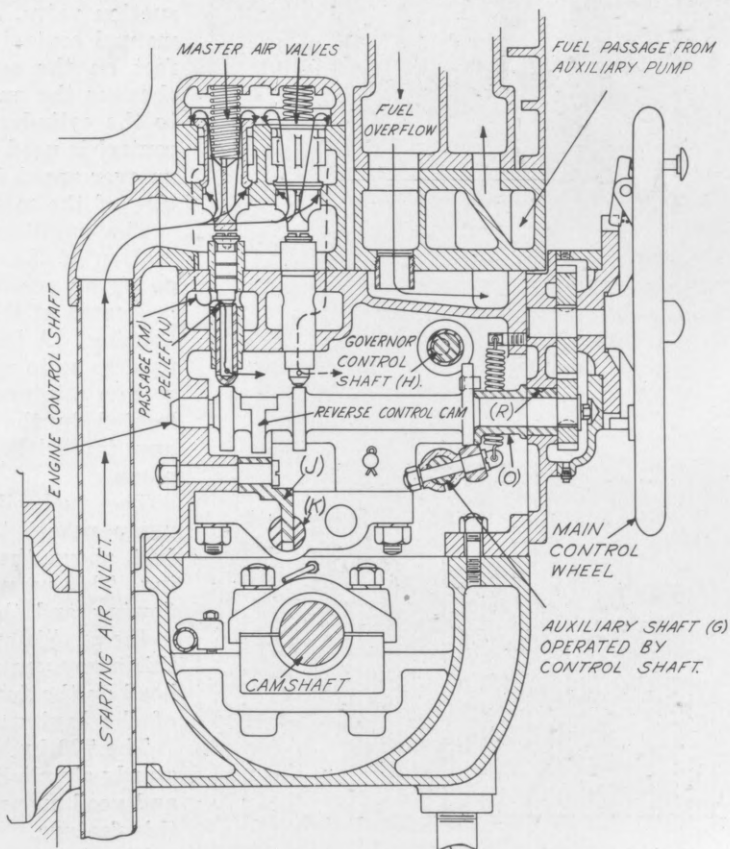
wheel is turned by the man on watch.

The cam (O) is loose on the engine control shaft and is held stationary by a ratchet device at (R). The pin (P) turns this loose cam around actuating the auxiliary shaft (G) and the governor control shaft (H) so that the fuel suction valves are held open when the control hand wheel is turned from the stop to the first starting position. This is a safety device to act in case the engine is not quite stopped when the operator begins to turn the hand wheel for the opposite direction of rotation.

The cam shaft also carries the cams which operate the fuel injection pumps. As the cam revolves it raises the injection pump roller which in turn actuates the injection pump plunger. It is not possible, however, for fuel to be injected through the discharge valve to the cylinder until the suction valve has closed. The closing of this suction valve is accomplished by means of a valve rocker actuated by the upward movement of the injection pump plunger. This suction valve rocker is



Section through governor unit showing speed control mechanism



Cross section of reverse mechanism showing master air valves

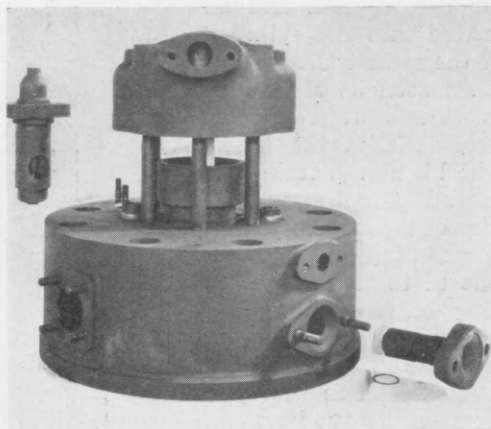
pivoted on a shaft and is turned through a slight angle as the pump plunger moves upward. As the rocker drops, the suction valve closes and the fuel oil is trapped so that its only course is through the discharge valve and to the cylinder.

Since the amount of fuel injected is dependent on the load carried by the engine, the suction valves have to be placed under governor control. The suction valve rocker is pivoted in eccentric bearings and the amount of rotation is determined by the position of the governor weights linked with this shaft as indicated on the sectional view of the governor. When the load on the engine is increasing, the suction valve closes earlier in the stroke of the pump plunger, and thus more fuel is injected.

Each cylinder has its own injection pump unit and each unit is bolted to the common pump housing. Adjustment for timing the closing of the suction valves is made by set screw.

The governor is of the flyball type, having a vertical spindle driven from the camshaft by a flexible drive bevel gear. As the engine speed increases or decreases, the weights swing at a varying radius and cause the sleeve to slide up or down the spindle. The governor yoke is keyed to a shaft which can turn slightly, and the movement of the shaft is transmitted to the fuel pump section valve rocker shaft as shown in the diagram. The adjusting screws are set for the correct cut-off of fuel at the rated horsepower and speed. Thus the governor controls the amount of fuel injection by regulating the effective length of the injection plunger stroke.

A large range of speed variation can be obtained by turning the speed control wheel. A reduction of speed is obtained by putting



Cylinder head assembly

tension on the speed control spring, which in turn pulls down the arm to which it is held at the top, acting to counteract the main governor spring. The control rod turns the fuel pump suction valve rocker shaft and thus has the same effect as if the governor weights were thrown apart. It holds open the fuel pump suction valves for a longer period of the injection stroke and decreases the amount of fuel injected.

There are times when it is desired to secure a more rapid variation in speed than is possible with the governor control hand wheel. To get any considerable variation in speed it is necessary to rotate this governor control wheel through several revolutions. In marine service, it may be necessary to vary the speed of the engine through a wide range such as in harbor maneuvering. In certain classes of stationary engine work such as in the operation of a dredge or the operation of excavating machinery it may be necessary to change the speed of the engine rapidly. Speed control through the governor is hardly sufficiently rapid in these cases.

Consequently a manual control device has been added consisting of a hand wheel which operates the governor yoke shaft and thus the governor linkage controlling the suction valve. A slight movement of this manual control wheel has an immediate effect on the speed of the engine since it changes the amount of fuel being injected to the cylinders. When the manual speed control is used, the governor acts simply as an over speed device for the particular setting of the manual control.

The auxiliary pump which supplies the suction of the fuel injection pumps is driven by an eccentric from the camshaft and is located at the end of the injection pump housing. A link motion and crosshead are used so as to reduce the wear on the plunger to a minimum. A removable strainer is located in the casing to prevent passing any impurities on to the fuel injection pumps.

The fuel oil pumped by the auxiliary pump passes to a small reservoir located just above the fuel injection pump housing. This reservoir is kept constantly overflowing and this overflow is carried back to the auxiliary fuel pump suction. Through this arrangement there is always a constant head on the fuel injection pumps regardless of the load on the engine.

The 720 hp. engine has an appearance of sturdy simplicity. The full box frame lines and good proportions, all tend to accentuate this feature.

The lower engine base is designed so

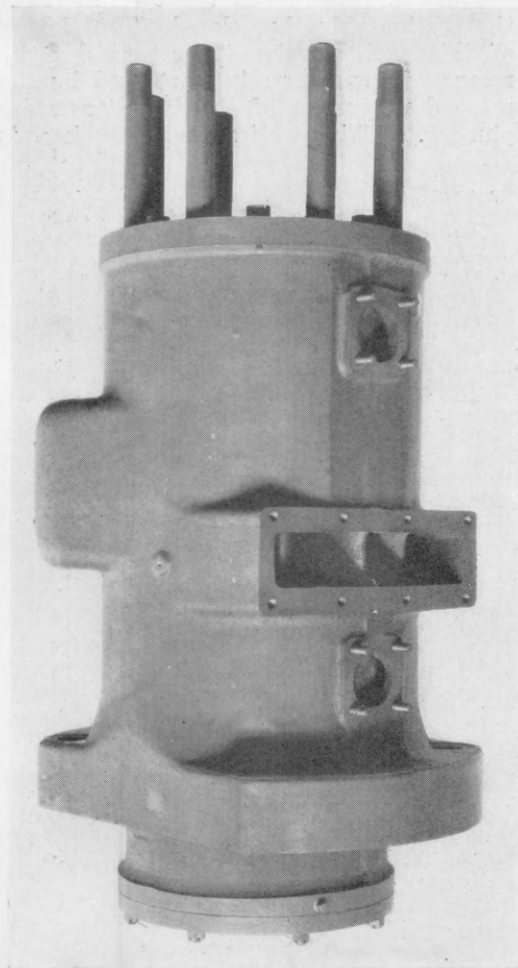
that the crankshaft center line is only a few inches above the floor level. This keeps the height of the engine above the floor line at a minimum and in the case of the marine engine without handrails, this dimension is only about 10 ft. The maximum clearance above the floor for pulling pistons is 17 ft. 6 in. Width from the control wheel to the exhaust manifold flange is 7 ft. 11 in., and the overall length of the lower base is 20 ft. 10 in.

Crankshaft and main bearings are 10 in. in diameter. All bearings are made long and all bearing pressures are well within conservative practice.

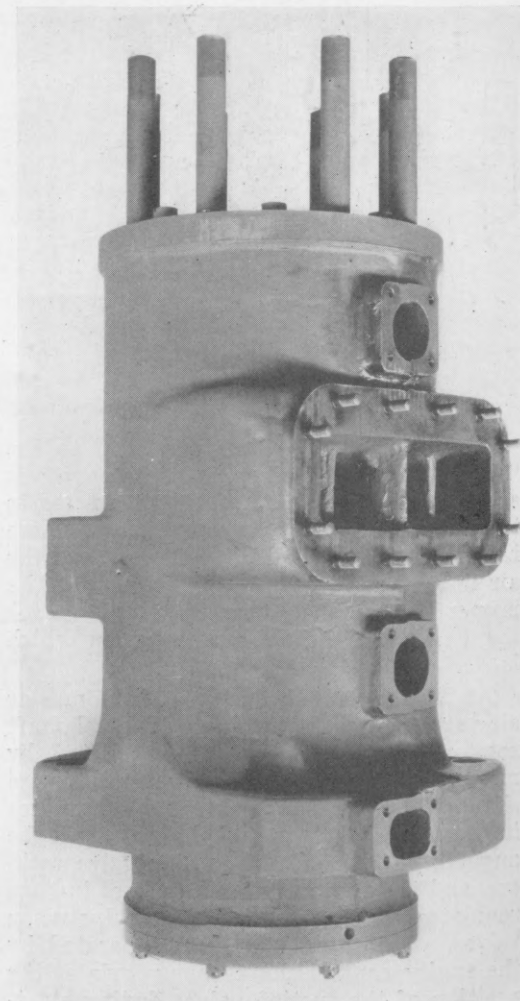
Due to the fact that the pressure lubrication eliminates ring oiling and the necessity for accessibility for inspection, the upper base is cast in one piece. The access floors to the upper base are, however, large enough so that a man can enter if it is desired to inspect the crankshaft bearings.

A special grade of iron containing approximately 20 per cent. of steel is used in casting the cylinders. This metal produces a hard, close-grain, uniform casting with excellent wearing qualities. Each cylinder also goes through a curing process to relieve any internal strains although this curing is in no sense an annealing process and does not tend to soften the cylinder. The cylinder is totally water cooled with large water jacket spaces extending more than its working length. Water spaces are also provided in the bridges of the exhaust ports.

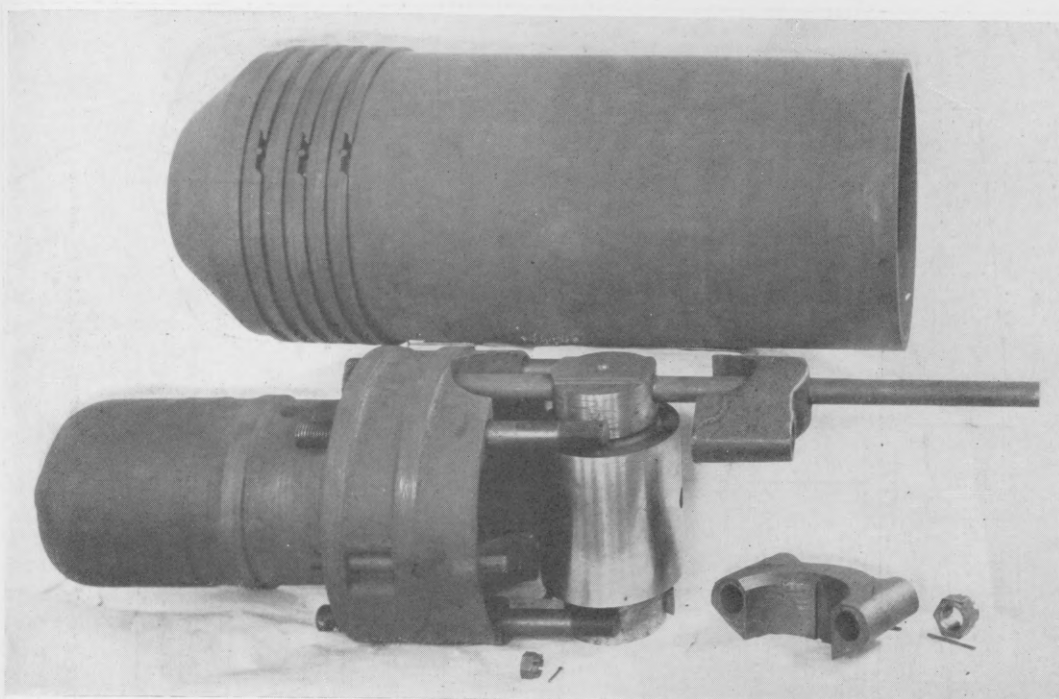
The most interesting feature of the cylinder construction is the insertion of the four wiper rings. The lower part of each cylinder is bored out to a greater diameter than the piston. The four wiper



Cylinder casting showing scavange ports



Cylinder casting showing exhaust ports



Showing long trunk type piston assembly and cooling arrangements

rings are then placed in this recessed portion of the cylinder and are held in place by a sleeve bolted to the bottom of the cylinder. The rings are clamped in position by this sleeve and yet are so designed that they will wipe against the piston at every point around the circumference. The sleeve itself is centered in the cylinder by three rows of bosses which are evenly spaced around the sleeve and which are then accurately machined. The oil collected by the wiper rings drains into the spaces left between the cylinder and the sleeve, runs down to the bottom of the sleeve between the bosses, and is taken out by a small pipe and drain header as shown in the transverse section of the engine.

Cylinder heads are also made of a special grade of iron containing approximately 20 per cent steel. They are made in two pieces, the lower half being bored out to receive a sleeve. This part of the construction shows quite clearly in the transverse section. The design is symmetrical, simple types of castings are used so that the internal strains are minimized, and the entire head is thoroughly water cooled.

The water connection between the center head and cylinder is made by short pipes and individual ring gaskets instead of depending on the cored holes and a large gasket. It is a positive type of connection and practically eliminates the possibility of leakage at this point.

An air valve is located in the head for the starting air inlet. The fuel injection nozzle is located in the upper half of the cylinder head or combustion chamber. A

block is also provided for taking indicator readings and a thermometer is placed in the water jacket for taking circulating water temperature readings for regulating the water supply.

The connecting rods for these engines are forged from a solid billet of open hearth steel and are machined to close limits to insure absolute interchangeability. The piston pin end is accurately bored out for the bushing. This bushing is made from a special bronze and is pressed into the upper end of the connecting rod and is then scrapped to fit the pin. Two dowels hold it securely in place. Reliefs are cut in both sides of the shell next to the pin where little or no pressure occurs. This prevents binding under expansion and these spaces also act as oil reservoirs from which the oil is fed to the pressure areas.

Aside from circumferential webs and the shoulder for bolting on the piston pin assembly, the piston is an open casting. The piston pin hubs are not a part of the piston proper since the piston pin assembly and seal for the cooling oil is a separate cast steel assembly.

The long trunk type piston in this construction is entirely free from any break in its bearing surface. The longitudinal section of the engine gives a clear idea as to how the piston pin assembly fits into the piston and how the piston cooling oil is circulated.

The double acting scavenge pump which is built in as a part of the engine has a cylinder diameter of 31 in. It has all passages of large area and a stream line flow of air.

The capacity is sufficient to maintain air pressure practically constant in the scavenging air manifold at about 2½ lb.

The water cooled exhaust manifold consists of two castings connected at the center by a special "T" connection which can be swung at various angles so that the exhaust can be taken away from the engine in a number of positions. It is also possible to take the exhaust out at the flywheel end of the manifold. "Clean-out" plates are also provided so that it is possible to clean out the water jacket and the gas chamber.

A large two-way ball thrust bearing is located on the after end of the crankshaft. This bearing is lubricated under pressure, and an oil throw ring and drain keeps any lubricating oil from creeping along the shaft and being thrown about the engine room.

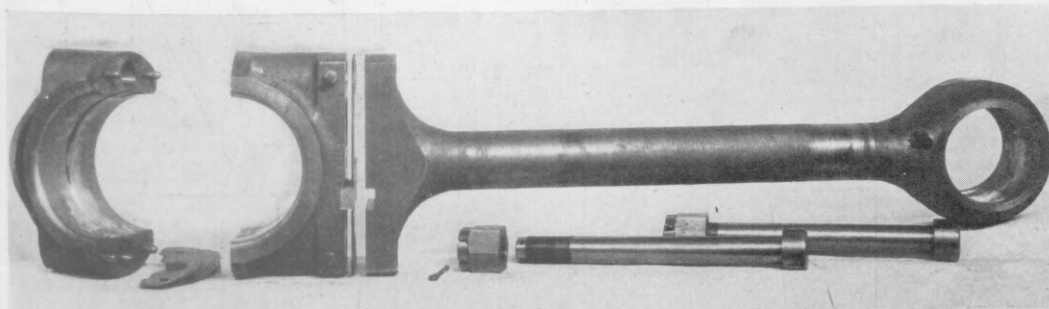
The camshaft is driven by a train of three solid forged steel spur gears. The drive gear is keyed to the crankshaft and transmits power to the camshaft gear by means of an idler gear running on a hardened and ground steel shaft supported by a cast iron jacket, which in turn is bolted and doweled rigidly to the upper base. Each meshing point of the gear train is lubricated by an oil spray.

Fordonian Flies Canadian Flag Again

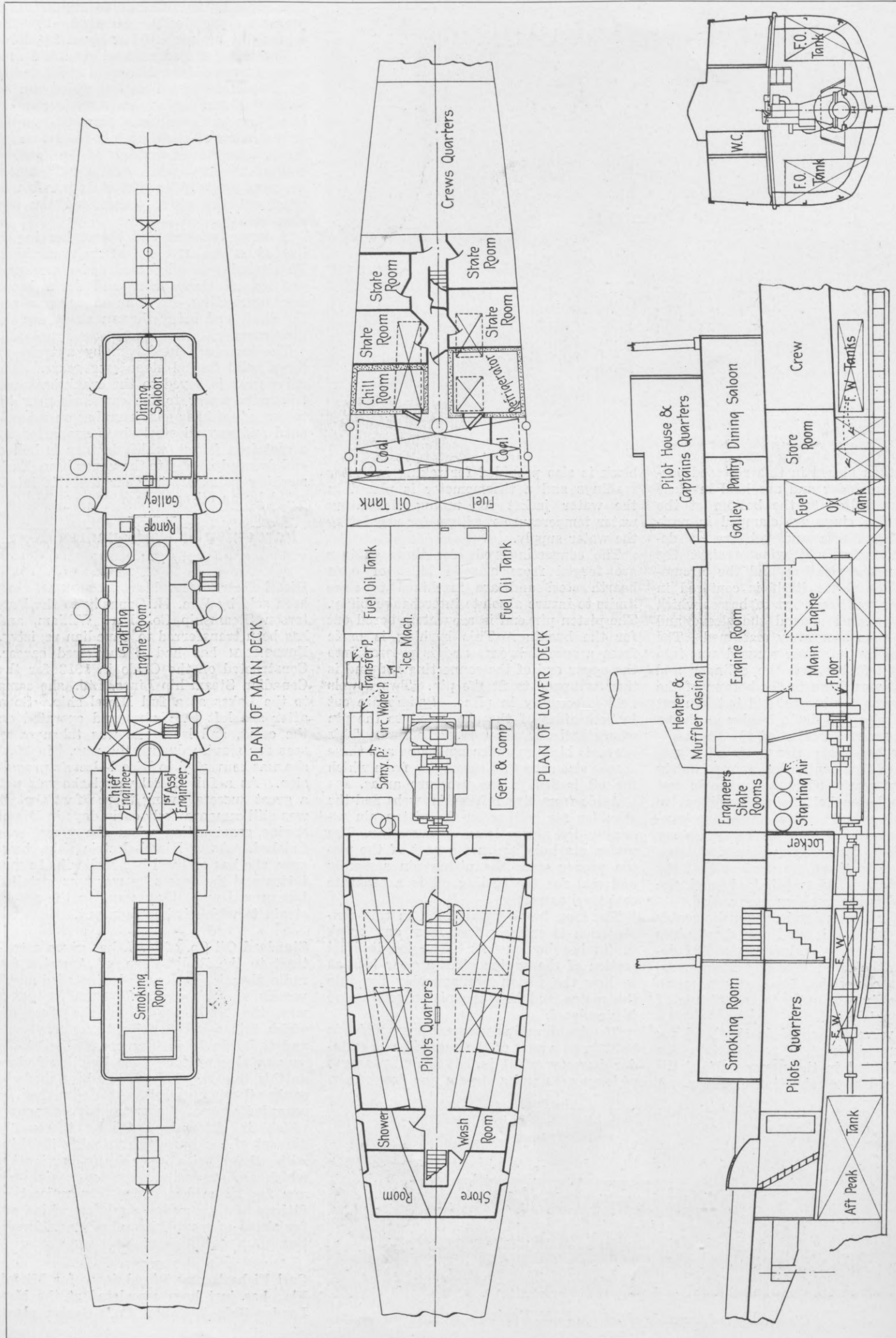
Diesel-electric freighter FORDONIAN has been sold by Wm. M. Connelly to the Patterson Steamship Co., Fort William, and has been transferred to Canadian registry. FORDONIAN has had a checkered career. Constructed on the Clyde in 1913 for the Canadian Steamship Lines, Ltd., she came to the Lakes as a full Diesel ship. Soon after she left the Lakes and operated on the coast, and later she was taken overseas for service during the war. In 1922 she was converted to Diesel-electric propulsion. As a full Diesel vessel she was not a great success, owing to the fact that it was still comparatively early days in Diesel engine construction when the vessel was finished. As a Diesel-electric ship, however, she has outlived her earlier bad reputation and the type of power now installed has proved more than equal to the severe strain to which it has been put.

Standard Oil Co. of N. J. has given a contract to the Radio Corp. of America for radio direction finders to be installed on 29 vessels of their fleet. WALTER JENNINGS was the first vessel in the fleet on which this navigational aid was tried out, and it is stated that owing to the highly successful operation of the direction finders on this ship the decision has been made to equip all other vessels. The step may be regarded as one of a progressive company, which is determined to be thoroughly abreast of the times in equipping its ships with those scientific aids to navigation which are gradually becoming a *sine qua non* for all modern ships. In respect of fittings of this nature, American ships are far ahead of most ships of other nationalities.

Carl Fisher's new Diesel ferry for Miami, Fla., has just been completed at the New London Ship & Engine Co.'s Groton plant.



Connecting rod assembly of 720 hp. F. M. Engine



General arrangement plan of pilot boat *Carmina*, converted from steam, shows how main Diesel engine and reduction gears are arranged in a compact machinery space

Pilot Boat Propulsion Revolutionized

Conversion of Carmina from Steam to Diesel Drive
Increases Cruising Radius Sevenfold

IDLE for nearly 5 years because her steam machinery was uneconomical to operate, the pilot boat CARMINA, converted to Diesel power and with the rest of her equipment improved in line with her modern propelling machinery, has now taken up her duties at the entrance to Chesapeake Bay, her cruising radius increased sevenfold. A 6-cylinder 4-cycle airless injection Diesel engine has replaced an 8-cylinder triple expansion steam engine and two cylindrical boilers because with the latter installation the ship could remain on station for a maximum period of only 7 days without returning to port for refueling. With the new installation the cruising time will be increased to 50 days. In order to obtain maximum maneuvering ability with control from the pilot house through purely mechanical as opposed to electrical methods, the main prime mover is coupled to the propeller through the medium of Falk reduction gears, Falk-Bibby couplings and Metten clutches, the layout being practically a repeat of the arrangement installed in the Cornell Steamboat Co.'s towboat CORNELL and on the New York Central Railroad's towboat No. 21 described in July and August, 1926, issues of MOTORSHIP, respectively.

In addition to the advantages mentioned above, Diesel drive in CARMINA saves fuel consumption in comparison with a corresponding steamer when in motion and reduces the fuel consumed to a negative quantity when stationary. The peculiar duties of a pilot boat involve waiting for steamships to arrive or leave the entrance to a harbor, drifting with the tide, laying at anchor for long periods, and waiting to place aboard or remove a pilot. In steam

power plants, this necessitates burning coal to keep up a sufficient head of steam to move rapidly when required. With the Diesel installation the vessel will not use fuel except when cruising.

Chief Characteristics of Carmina

Length on waterline.....	141 ft. 0 in.
Length b. p.....	140 ft. 1 in.
Beam, molded.....	21 ft. 6 in.
Depth, molded.....	11 ft. 6 in.
Draft, forward.....	9 ft. 0 in.
Draft, aft.....	11 ft. 0 in.
Gross tonnage.....	260 tons
Net tonnage.....	148 tons
Power.....	400 b.hp.
Speed (full power).....	12.26 kts.
Speed (service).....	10 kts. approx.

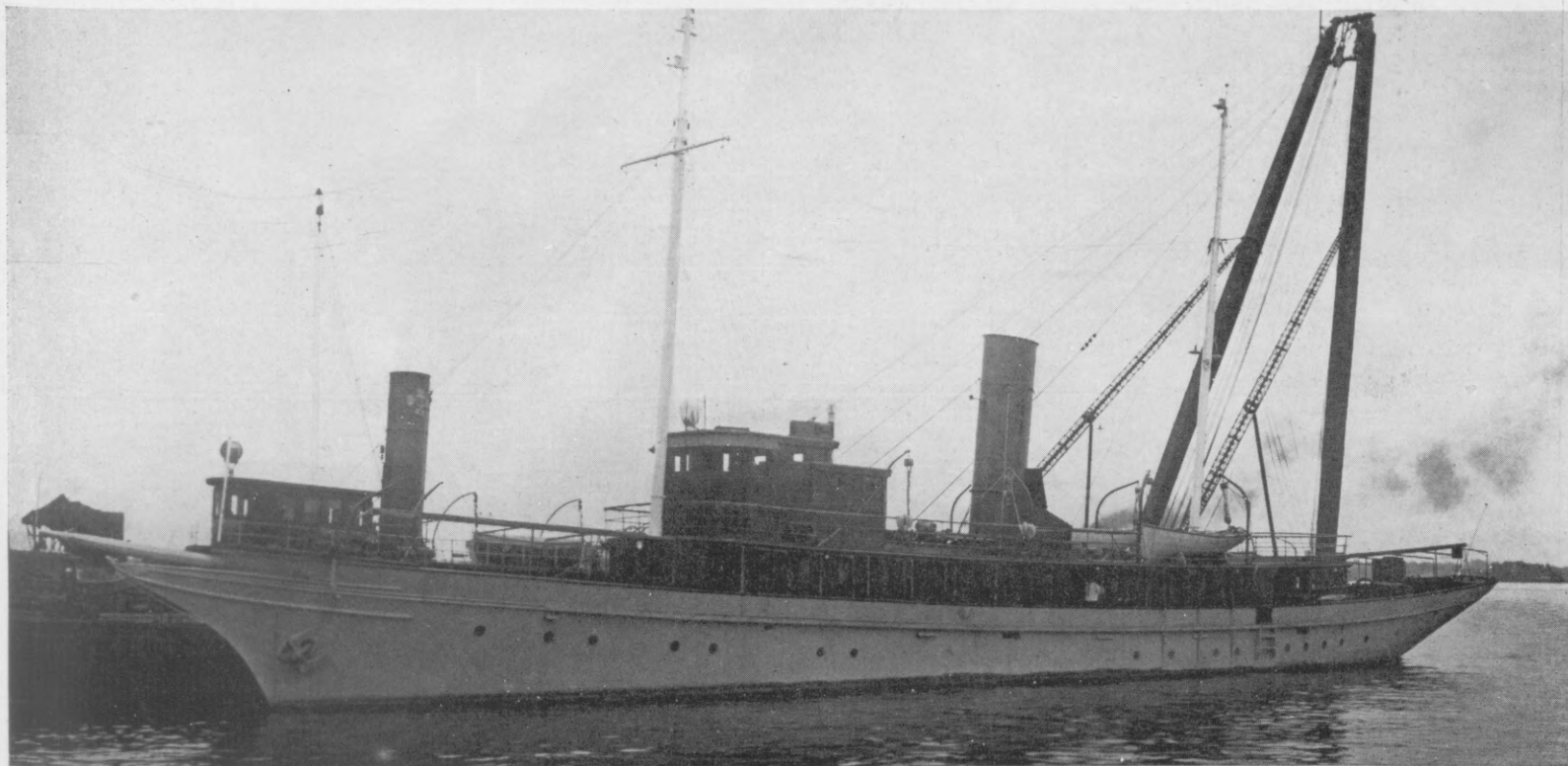
CARMINA was built in 1903 as a pleasure yacht with luxurious appointments. Her hull has usual graceful yacht lines with clipper bow and long counter stern. She was taken over in 1917 by the Association of Maryland Pilots, an association of 45 captains owning four steamers and one sailing cutter. For the next four years she was used as a pilot boat in the waters of the Chesapeake Bay, but due to costly operation, short cruising radius, and the necessity of being taken off station at frequent intervals for refuelling she was withdrawn from service in 1921 and then lay idle at her pier in Baltimore until the owners decided to convert the ship to oil engine motive power. Tenders were invited from several oil engine manufacturers and the owners accepted the specifications and design submitted by the Kensington Shipyard Department of the Cramp Company, Philadelphia, for the installation of a 400 hp. engine manufactured by the De La

Vergne Machine Company, a subsidiary of the Cramp Company.

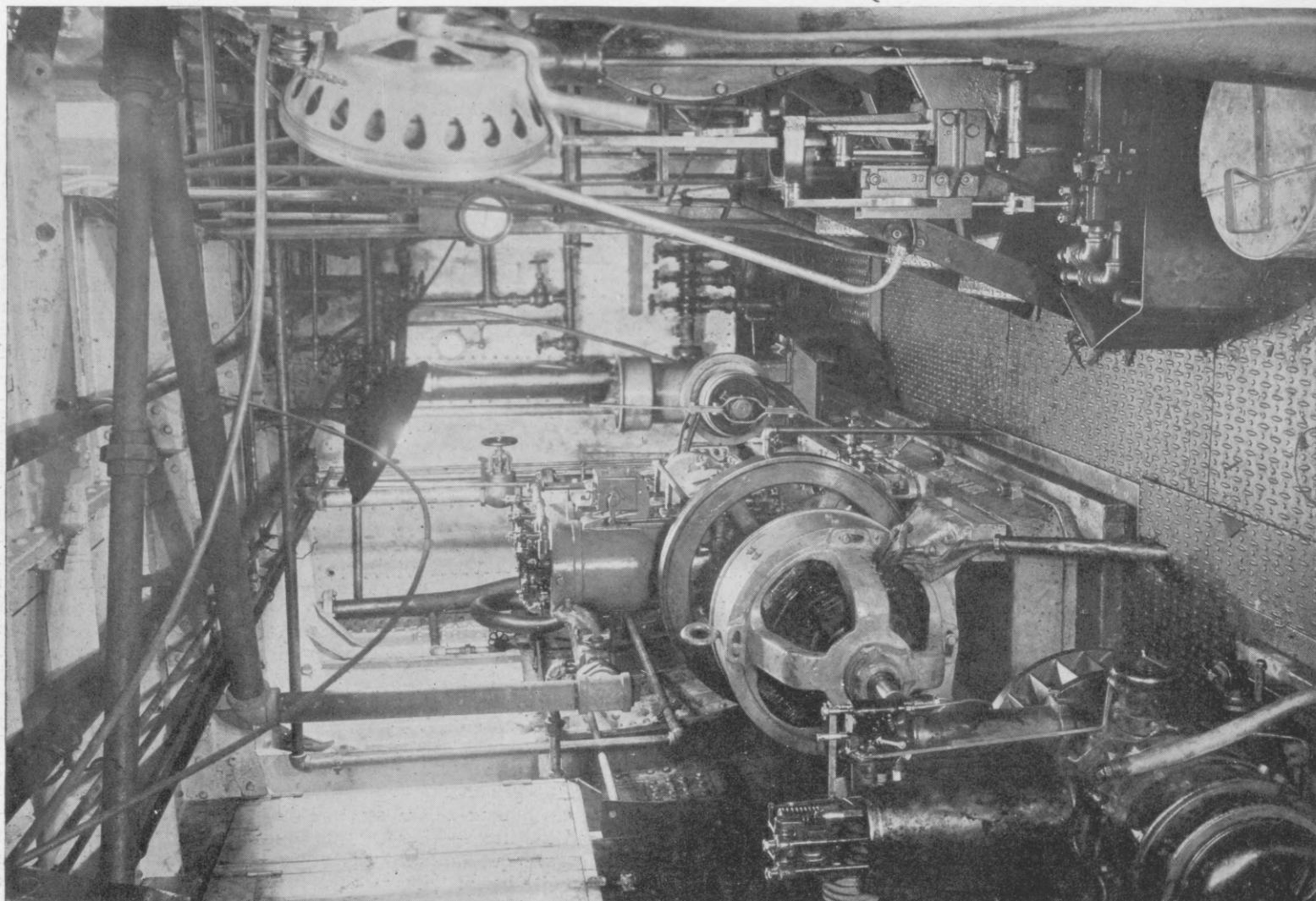
The whole of the conversion and constructional work involved was carried out under the personal supervision of Howard Fishe, general manager of the Kensington Shipyard. The work was of an extensive nature and involved the partial gutting of the original engine room and its preparation to receive the new propelling machinery, the original machinery, boilers and stack having been lifted out before the vessel's arrival at the yard. The bulkhead separating the original engine and boiler room was cut down to a web frame and the new machinery installation having a total length of 32 ft. accommodated in this space. The engine occupies a considerable portion of the boiler room while the gearing and clutches occupy most of the space taken up by the original triple expansion engine. Extra longitudinal side stringers were built into the ship in way of the machinery.

Three fuel oil tanks each of 50 tons capacity have been built in at the forward end of the new machinery space—one athwartships and two fore and aft. These are stopped just short of the deck overhead. The same shafting line has been used except that the thrust shaft has its flange turned off and fitted with a shrunk coupling at the forward end where a Falk-Bibby flexible coupling is fitted. A new propeller of manganese bronze 7 ft. diameter by 7 ft. 3 in. pitch designed to operate at 150 r.p.m. replaces an old propeller of similar material 8 ft. 3 in. diameter by 10 ft. 0 in. pitch.

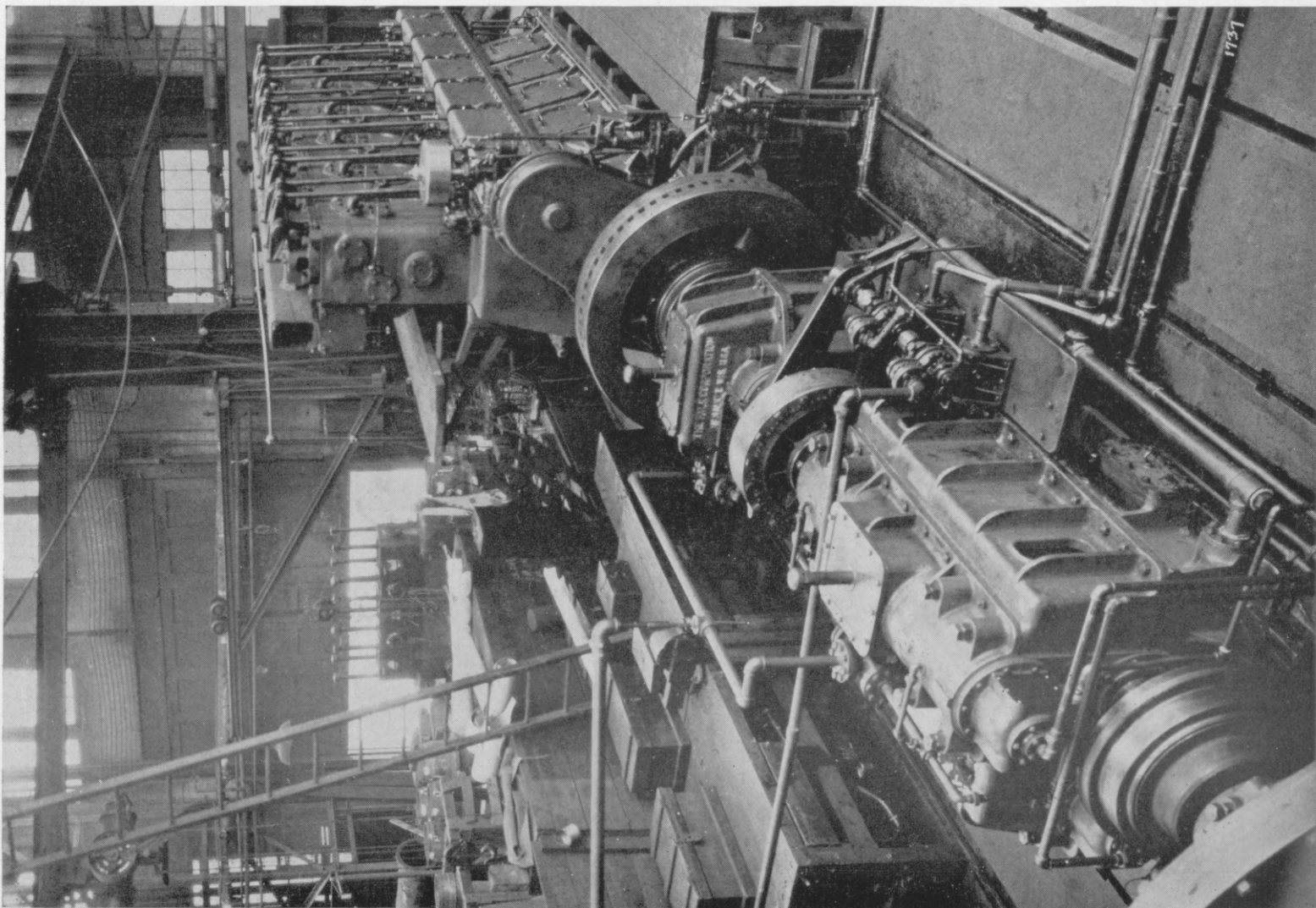
The main engine which develops 400 b.hp. at 277 r.p.m. has six cylinders 14½ in. diameter by 18 in. stroke. Each cylinder



Pilot Boat Carmina, converted from steam and modernized, retains the easy graceful lines of a yacht, combined with seaworthiness



Carmina's auxiliary machinery includes a generator set operating compressor and bilge pump



Pilot house-controlled engine drives propeller through reduction gears and flexible couplings

is provided with an individual fuel pump located in front of it and actuated by the valve shaft. Fuel delivery is regulated by a governor at the after end of the engine, and a constant head on the suction side is maintained by a small float tank at the forward end. The injection pressure into the cylinder is approximately 2000 lb. per sq. in. Compressed air, which in this arrangement is used only when starting up and is not required for maneuvering, is supplied at 200 lb. per sq. in. by a small compressor driven by an 18 hp. Diesel, driving in addition the electric generator operating the lighting system, and the bilge pump.

Drive through the Falk reduction and reversing gears is controlled by the Metten type hydraulic clutch. Two sets of pinions mesh with the main low speed gear, each set being driven through a clutch. These clutches are interlocked so that when one is thrown in, the other is automatically released. They consist of steel and fiber disks pressed together or released by the action of oil under about 80 lb. per sq. in. pressure, the oil being led to the clutch through the hollow shaft on which the latter is carried. With the control lever in the middle of its arc, both clutches are free, the engine running idle and turning only the portions of shaft forward of the clutches and their attached gears. The control lever also is attached to the engine governor in such manner that in middle position the fuel supply is reduced to just sufficient to keep the engine running. As the lever is moved in either direction, the amount of fuel admitted is automatically increased and the speed of the engine held constant in any position at which the lever is allowed to remain, ahead or astern. Immediately the motion of the control lever ceases, the governor takes charge and holds the engine steady at the speed corresponding to the former's position, thus preventing racing or other change of engine speed due to outside causes. A Falk-Bibby coupling connects the engine to the gears and a second similar flexible connection is arranged between the gear case and the propeller shaft, thus protecting the gears from any damage due to hull or local distortion and consequent misalignment and also allowing for a very slight longitudinal movement of the forward shafting and gears due to the operation of the clutches when the vessel is going ahead or astern.

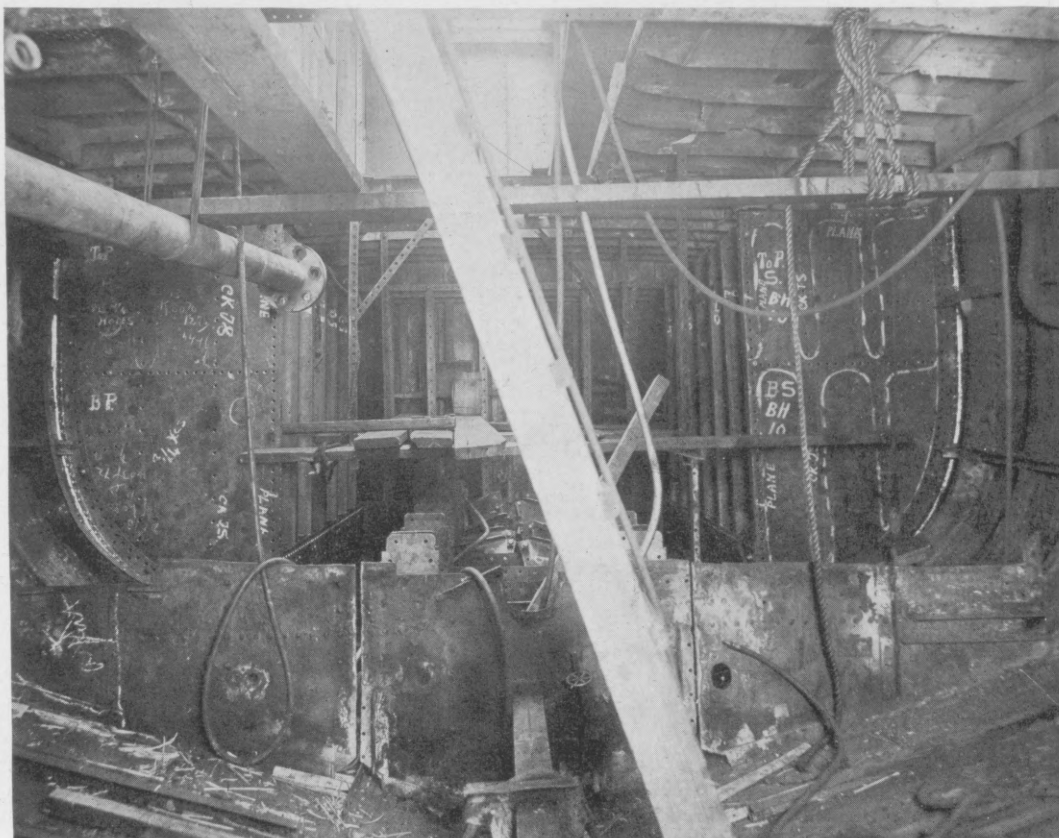
The entire motive unit was assembled in the engine builder's shop and tested for several days to classification requirements

prior to delivery to the Philadelphia plant.

In connection with the main engine drive the usual auxiliary equipment, such as air storage tanks, lubricating oil tanks, and filters and spares, is installed. Starting air is carried in three bottles of 27 cu. ft. capacity. A special design silent exhaust muffler in the oval stack, equipped with a

chain driven from the gear shaft. A one ton refrigerating machine is also provided, together with refrigerating space, chill rooms and a separate ice-making unit.

The vessel is provided with an electric-hydraulic ram type steering gear connected to the rudder stock and arrangements are made whereby steering can be very quickly



Showing Carmina's engine room at an early stage of the conversion

baffled intake pipe to the engine, entirely eliminates noise. The stack is built out at its lower aft end to take the top of a Davis waste heat boiler, which is used for heating the vessel, and is operated by the engine exhaust gases when under way and by an oil burner when the main engine is shut down in port.

The pump outfit includes a gear type lubricating oil pressure pump, hand operated lubricating oil pump, motor driven fuel oil transfer pump, hand operated fuel oil pump, two motor driven centrifugal jacket water pumps (one of these for emergency), two motor driven sanitary pumps with regulators to the pressure tanks for fresh and salt water systems, a clutch pump and a lubricating oil return pump both

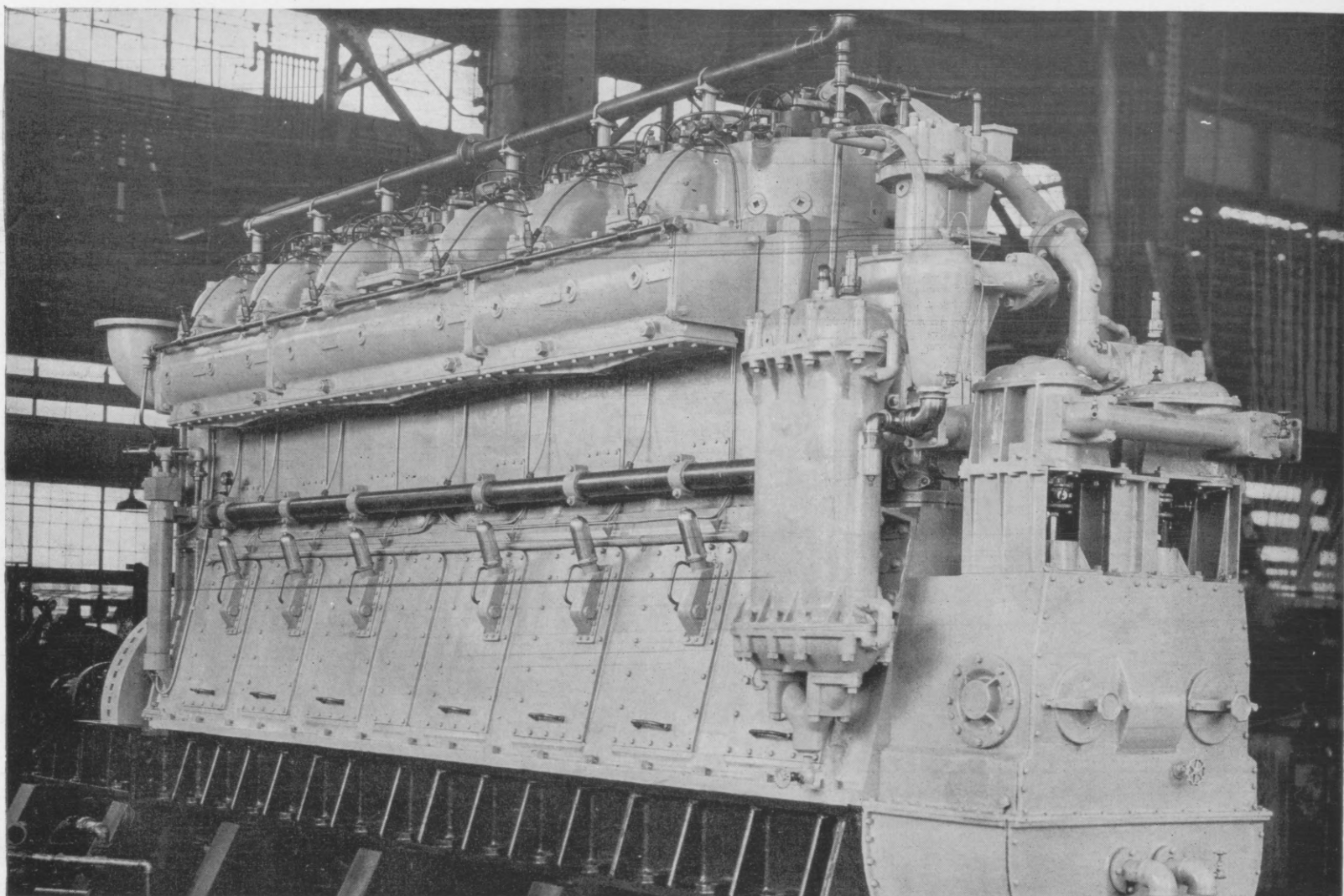
changed over to the hand screw gear on deck, in emergency. An electric gear-driven windlass is also part of the equipment.

Advantage was taken of the ship's presence at the repair yard to remodel and alter some of the accommodation. This comprised the removal of the galley from the lower deck forward into the main deck-house aft of the dining saloon. Quarters for the engineers, two operators and one oiler, were also moved into this deckhouse. A commodious room for 18 pilots has been arranged on the lower deck aft.

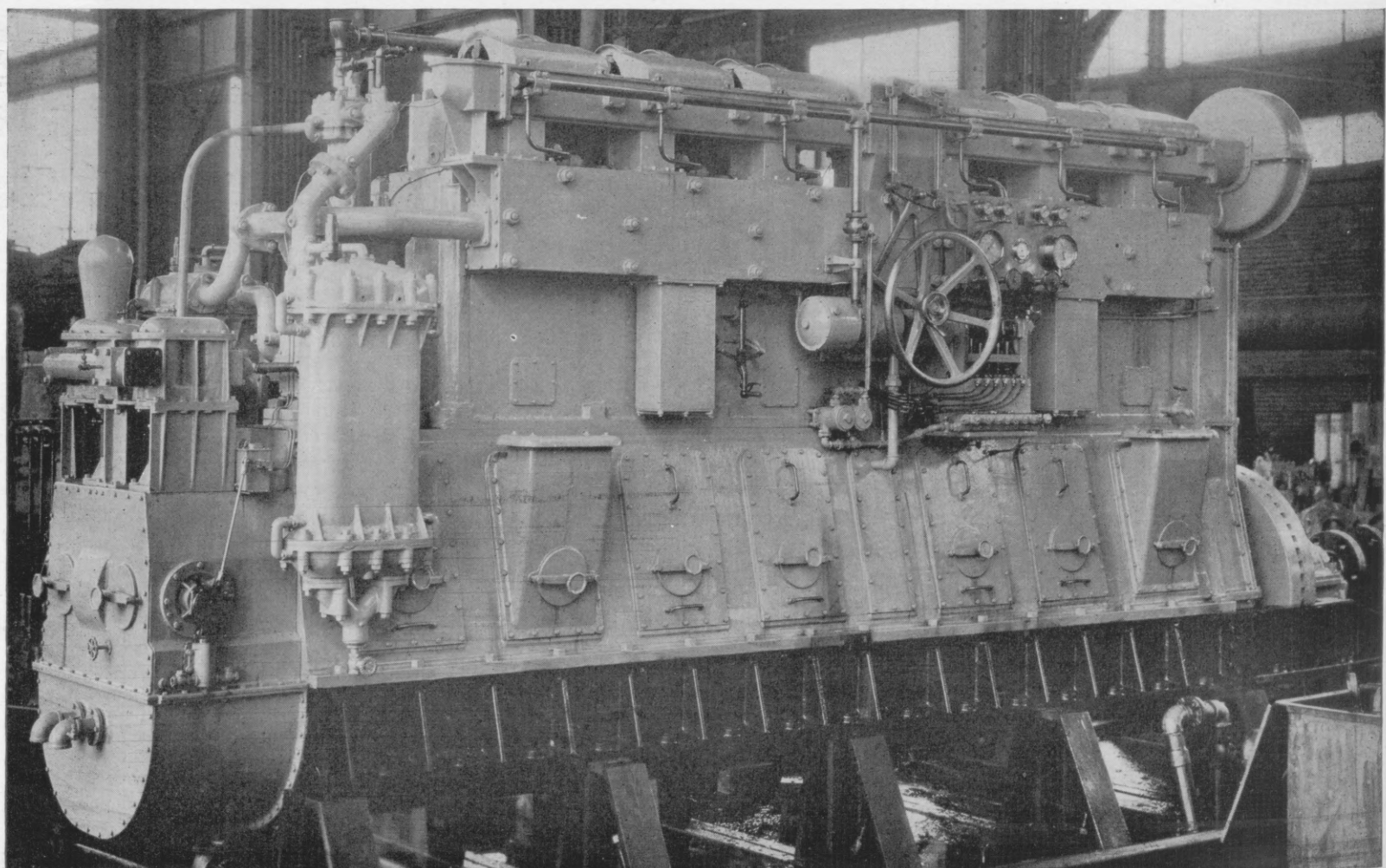
The old engine room telegraphs are retained in the pilot house but these are now direct coupled to the clutch pump controls. Equipment for conveying pilots to and from their ships comprises four boats.

Details of Principal Machinery Equipment of Pilot Boat Carmina 140 ft. 1 in. b.p., 400 b.hp.

ITEM NO.	NAME	MAKE	QUANTITY	CHARACTERISTICS
1	Main engine	DeLaVergne	1	6-cyl., airless injection, single acting, 14½ in. x 18 in., 277 r.p.m., 400 b.hp.
2	Propeller	Cramps	1	Solid mang. bronze, 7 ft. 0 in. diameter x 7 ft. 3 in. pitch.
3	Gears	Falk	1	Falk-Bibby couplings, Metten clutches, reduction ratio 1.108 to 1.
4	Main generator set	Hill	1	12 kw. direct current, 18 hp. kerosene engine, also driving compressor and Northern bilge pump.
5	Switchboard		1	On starbd. side.
6	Ice Machine	DeLaVergne-Diehl	1	1 ton capacity.
7	Lub. oil pressure pump	Northern	2	Gear driven.
8	Lub. oil pump		1	Hand driven.
9	Fuel oil transfer pump	Northern	1	Motor driven.
10	Fuel oil transfer pump		1	Hand driven.
11	Jacket water pump	Northern	2	Centrifugal, motor driven.
12	Sanitary pump	Northern	2	Motor driven, regulators to pressure tanks for fresh and salt water.
13	Emergency generator set	Delco	1	Gasoline engine driven.
14	Waste heat boiler	Davis	1	Arranged in base of stack.
15	Windlass	Diehl	1	Motor, gear driven, 115 volt.
16	Steering gear	American Engineering Co.	1	Electric-hydraulic, fitted aft under hand screw gear.



Starboard side of the new Winton engine, with injection air compressor and pump units in foreground, shows compactness of designs



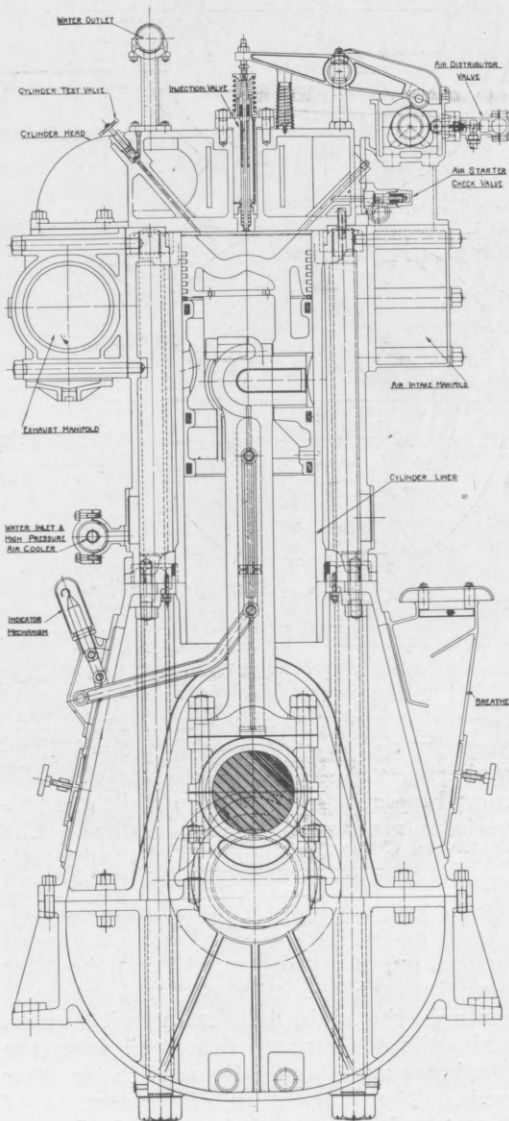
Control station of the new 800 hp. Winton Diesel is easily accessible on the port side of the engine at about mid length

Latest Winton Diesel Is 800 hp. Unit

Main Features of a New Model Specially Designed for
Yachts Towboats and Ferryboats

DEVELOPING 800 b.hp. at 300 r.p.m. and incorporating many refinements and improvements, the latest model Winton Diesel engine has now been placed on the market, and with it the Winton Engine Company definitely enters the larger size Diesel engine field. The engine is unusually compact, and shows clean symmetrical lines, while the construction permits exceptional strength and rigidity.

The new model has six cylinders $16\frac{1}{2}$ in. diameter and 22 in. stroke and with these dimensions it develops 800 b.hp. at 300 r.p.m. It is also manufactured, with the same cylinder diameter and a longer stroke—viz. 26 in., to develop 800 b.hp. at 250 r.p.m. The highest powered Winton Diesel prior to this model, it should be noted, developed 600 b.hp. at 450 r.p.m. with cylinder diameter 14 in. by 15 in. stroke. The newest model with its slower r.p.m. is therefore of value to towboats and other craft in which the engine is direct coupled to a fairly slow running, large pitch propeller. Like its predecessor, the engine works on the 4-cycle air injection principle. It is self-contained, driving its own compressor, cooling water circulating pump, lubricating oil pump and fuel pump. The weight complete is 110,000 lb. The over-all length is 26 ft. $7\frac{1}{4}$ in., maximum width 14 ft. $4\frac{3}{4}$ in., and height above engineroom floor 10 ft. $8\frac{3}{4}$ in. The model is designed and constructed to meet the requirements of Lloyds Register of Shipping and the American Bureau of Shipping.



Cross section through 800 hp. engine

Following are the principal characteristics summarized:

Winton 800 hp. Model Characteristics

No. of cylinders	6
Diameter	$16\frac{1}{2}$ in.
Thickness of cylinder wall	$1\frac{1}{2}$ in.
Stroke of piston	22 in.
Speed	300 r.p.m.
Diameter of flywheel	63 in.
Diameter of main shaft	$10\frac{1}{2}$ in.
Diameter of connecting rod (outside)...	6 in.

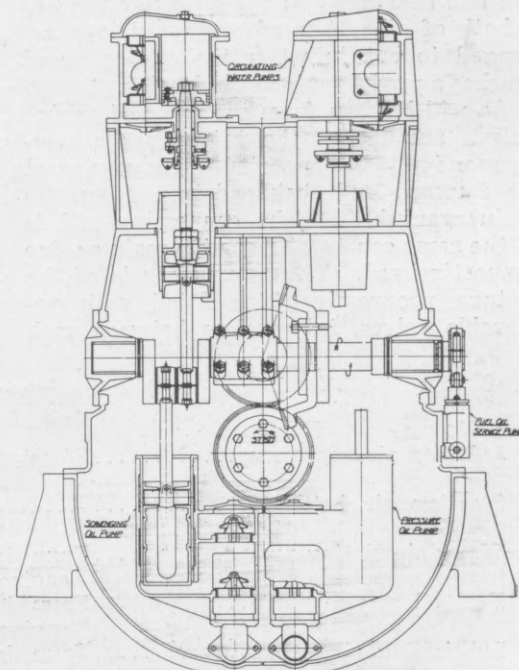
The engine structure is built up in three main portions viz.: the bottom half crankcase, the top half crankcase and the water box, all of which are of cast iron bolted together by sixteen 3 in. chrome-vanadium steel through bolts treated to a tensile strength of 158,000 lb. per sq. in. This arrangement eliminates all tension from the cast iron and provides the three units with strength and rigidity.

The bottom half crankcase, which is heavily ribbed, carries the crankshaft in nine main bearings and extends aft to receive the thrust bearing base. The top half crankcase is bolted to the bottom half crankcase and has large hand holes pro-

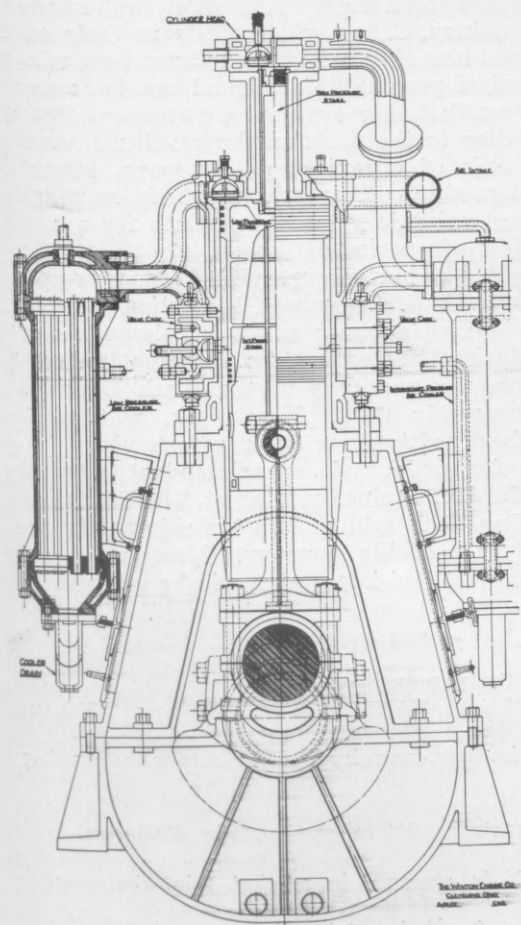
vided for the inspection of all main bearings and connecting rod boxes. The water box is a one piece casting, flanged and bolted to the top half crankcase and provided with cleaning holes as well as ample cooling space for the cylinders under all conditions. The water box casting contains six charcoal iron cylinder liners. These liners are machined and ground to mirror smoothness and are so constructed as to be easily removed, a point which is helpful in reducing upkeep. They are machined on both sides which provides uniform thickness, resulting in maximum and even cooling of liners and pistons. The liners are sealed at the top by the cylinder head and a gasket, and are tightly packed at the bottom by stuffing boxes. The cylinder heads are designed to be readily detachable without requiring the removal of intake or exhaust manifolds. These are constructed of close grained charcoal iron and are cast individually. They are thoroughly water jacketed and are secured to the water box by studs of high carbon steel. Each cylinder head carries six removable valve gauges, two for exhaust, two for intake, one for injection air and one for starting air and relief.

The exhaust and intake valves are identical, being provided with ample space for cooling water, while the use of six dual exhaust and intake valves greatly reduces the upkeep. The valves themselves are forged of a special alloy steel, the head and stem being integral, which affords great resistance against oxidation, and enables them to withstand both severe usage and considerable heat. Heads and stems are forged integral.

Special interest attaches to the pistons in that they are made of Bu-Nite aluminum alloy which permits of an exceedingly light unit reducing the overall weight of the engine. Pistons are ground the full length



Cross section through pumps



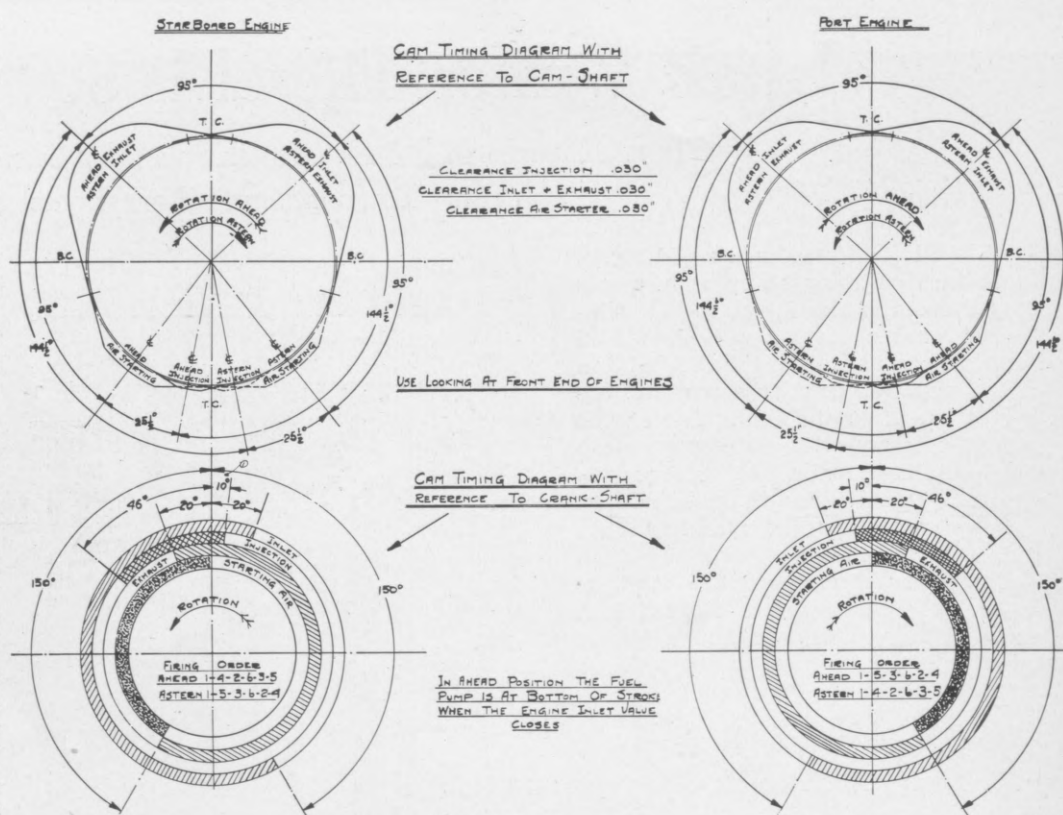
Cross section through compressor

and are fitted with six compression rings and one oil scraper ring. Bu-Nite piston pin bearings are carried in the piston and are lubricated by pressure from the main oiling system. Winton claims that by placing piston pin bearings in the pistons 40 per cent more bearing surface can be given to the piston pin than with the piston pin bearing in the rod. This is an important point since piston pin bearings are among the most severely stressed bearings in an engine. The wrist pins are made of Hy-Ten A-1 steel, hollow bored, hardened and ground, and clamped securely in connecting rod.

The camshaft which is arranged at cylinder top level is driven by spiral gears from the after end of the crankshaft. It is of built-up type and is made of high carbon steel. Two sets of cams are fitted, one for ahead running and one for astern running and reversing is accomplished by sliding the camshaft in a fore and aft direction, thereby bringing the reverse cams under the rocker arms. Reversal is carried out by means of a hand wheel operating a toothed quadrant and a lever motion. To start up the engine the hand lever controlling the starting air valve is pulled forward. Starting air then flows from the starting air bottle to distributor valves located on the camshaft pocket. From these valves, it flows into the cylinders in the same order as for firing. Starting air enters the cylinder when the crankshaft is at top dead center and the valve is closed when the crankshaft is about 30 to 35 deg. before bottom dead center. All cams are constructed of carbon steel, drop-forged and hardened, and held to the shaft by taper pins. The rocker arms themselves are steel castings, bronze bushed and they carry hardened steel rollers and pins at each end.

The main fuel pump is a 6-plunger unit and the fuel consumed by the engine cylinders is metered by cut-off valves which work on the suction strokes of the pump plungers. These cut-off valves are regulated by the governor which controls the engine speeds. The governor itself is of fly-ball type controlled by hand lever and specially designed for and adapted to this engine. The governor thrust bearings are ball bearings and the governor runs in a bath of oil. It is of overspeed type arranged to cut in when the engine speed reaches a predetermined fixed point.

As will be seen from the table of engine driven auxiliaries, the injection air compressor is direct connected to the engine at its forward end, being driven from the main crankshaft. The connecting rod is of the same construction as the main engine connecting rod. The compressor is of the 3-stage progressive type fitted with removable valves, intercoolers between each



Cam timing diagrams for new 800 hp. Winton Diesel

stage, and an after cooler. The cylinder is thoroughly water jacketed and is provided with removable plates for cleaning the water space. The piston is of Bu-Nite and the cylinder of special ground charcoal iron. The injection valve is of mushroom type opening inwardly, while the pulverizers are small perforated discs. The circulating water pump is of reciprocating type, gear driven and is fitted with Kinghorn valves. The lubricating oil pumps are of reciprocating type arranged so that one pump draws oil from the filter tank through the oil cooler and forces it through the main lubricating oil header, while the other pump draws oil from the crankcase sump and delivers it to the filter tank. The lubricating oil system is of force feed type, oil being delivered from the oil supply tank to a header in the case and from this header to the main bearings; thence it is carried through passages drilled in the crankshaft to the connecting rod bearings, up each connecting rod through a tube to the wrist pin sleeves and then to the wrist pin bearings in the piston. From the wrist pin bearings the oil drains to the crankcase sump. The oil which is drawn from the crankcase sump is delivered into a filter consisting of a series of screens.

The thrust bearing is of single collar type, the shaft of 9 in. diameter being of 30 per cent to 40 per cent carbon open hearth steel.

Five 800 hp. engines have recently been installed, two each in the motor yachts ARCADIA and SAVARONA, and one in the American Dredging Co.'s new dredge VIRGINIA. Others are on order and under construction.

Safety Congress

The fifteenth annual Congress of the National Safety Council will be held at Detroit from Oct. 20 to 25, and the program for the meeting of the marine section includes addresses by several well-known speakers. They will indicate in their papers how ship safety committees have minimized personal injuries and saved so many lives that they are now a permanent institution in the fleets employing them. As a result of organized safety work, several steamship companies own vessels on which no fatal injury has taken place for a considerable period of time.

D. N. Hoover, supervising inspector-general, U. S. Steamboat Inspection Service, will give a paper entitled, "Essentials of Marine Safety," while Capt. Asa F. Davison, vice-president of the Black Diamond Steamship Corp., New York, will speak about safety from an operator's viewpoint.

Arthur M. Tode, superintendent technical division, marine department, The Texas Co., New York, will explain the ship safety activities of his company. Many points of interest and importance will be covered.

Details of Engine-driven Auxiliaries on Winton 4-Cycle Diesel, 800 b.hp. at 300 r.p.m.

ITEM NO.	NAME	HOW DRIVEN	CHARACTERISTICS
1	Injection air compressor.....	Direct from crankshaft.....	3-stage progressive 15 in.-13¼ in.-3½ in. x 15 in. 300 r.p.m., 300 cu. ft. free air per min.
2	Starting air bottles.....		2-24 in. diameter x 10 ft. 4 in. long, capacity for 50 starts without using auxiliary compressor.
3	Water circulating pumps.....	From layshaft on front of engine	2 double acting, 6 in. x 7 in. stroke, 3½ in. suction, 3 in. discharge.
4	Fuel oil service pump.....	From layshaft on front of engine	1 single acting, 2½ in. x 1½ in. stroke, 1 in. suction, 1 in. discharge.
5	Lubricating oil pumps.....	From layshaft on front of engine	2 single acting reciprocating, 2-cylinder, 6 in. diameter x 7 in. stroke, 2½ in. suction, 2½ in. discharge.

Auxiliaries Capturing Arctic Trade

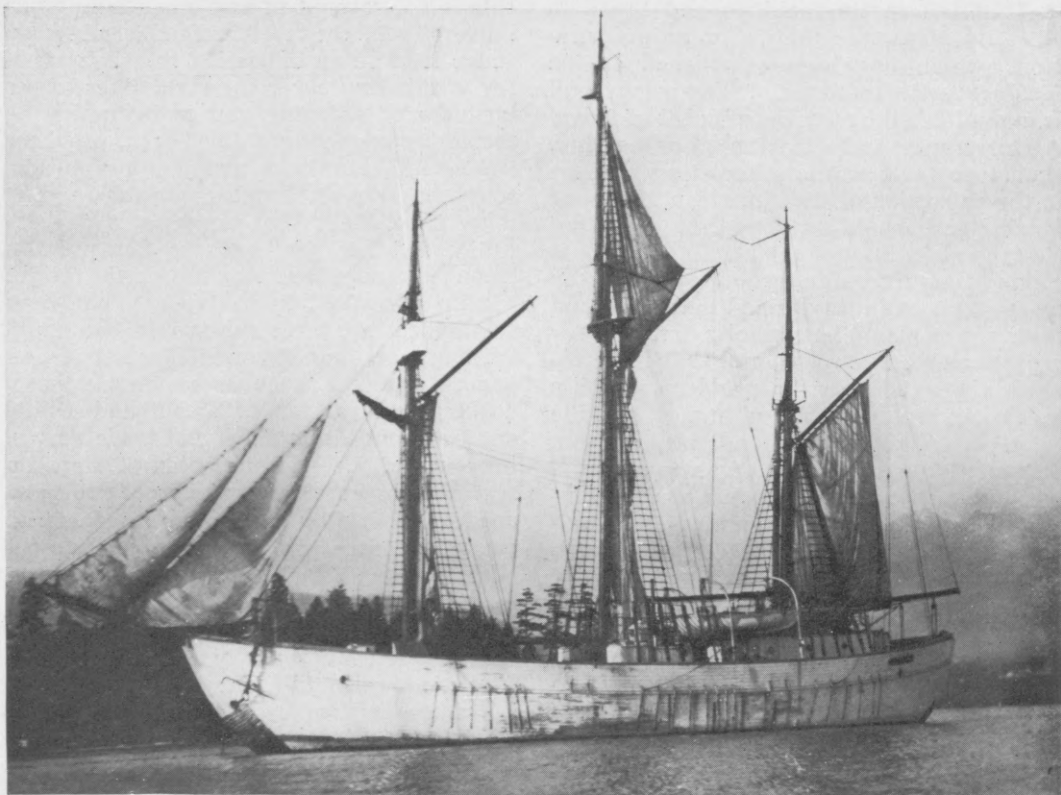
Five of Six Schooners Operating in Fur Trade Are Fitted with Auxiliary Diesels

K EEN competition is developing for the fur trade of the Canadian Western Arctic, and no less than six vessels have visited Herschel Island this summer, some of them continuing their voyage much further to the eastward. Of these, five were schooners or ketch rigged ships with auxiliary Diesel or surface ignition oil engines.

Hudson Bay Company which had many trading posts established on the northern coast of Canada purchased for the service Capt. Roald Amundsen's auxiliary schooner MAUD, which they have renamed BAYMAUD. MAUD was built in 1917 for Arctic exploration, and has been severely tested in the ice, first making the North East passage from Norway to Bering Strait, and then later in an attempt to drift across the North Pole in the ice pack. She was built in Norway and has 118 ft. overall length by 40 ft. beam, and is equipped with a 240 hp. Bolinder surface ignition engine. The hull is designed to lift if the pressure of the ice becomes very great, the midship section being nearly a half circle, while bow and stern are cut away so that they will easily ride up on the ice. As an additional safeguard against being disabled, the rudder and propeller can both be withdrawn through vertical shafts when the vessel gets jammed in the ice. Constructional work on this schooner is very strong. Ribs are of oak 12 in. square with only 1 in. spacing, planked with oak, and outside this is an ice sheathing of oak or greenheart. Inside the hull there is heavy ceiling over the frames, so that there is practically 22 in. solid wood in the vessel's sides. The hull derives great strength from the transverse beams of the 'tween deck which is arranged at about water line level. There is also additional diagonal bracing from the bilge stringers to main deck and 'tween deck beams. The stem is also heavily braced to meet the ice floes, and has an outer protection of heavy iron bars 1 in. by 4 in., spaced about an inch apart. The vessel has a three-masted schooner rig and the crew's quarters are on the main deck abaft the mainmast. MAUD replaces the Hudson Bay Co.'s schooner LADY KINDERSLEY, which was crushed in the ice pack and had to be abandoned near Point Barrow in 1924.

Another interesting schooner which went into the western Arctic this summer is Capt. Carl Klingenberg's 130 ft. schooner OLD MAID No. 2, formerly MAID OF ORLEANS. She was changed to Canadian registry this year. This schooner was built of fir in San Francisco for the lumber trade in 1882. She has been trading in the Arctic for a number of years, and appears to be as sturdy as ever in spite of her 44 years. She has a sheathing of ironbark for protection against the ice and a special bronze casting over the stem. She is equipped with a 150 hp. Atlas-Imperial Diesel engine with an oversize clutch, built for a 250 hp. engine, a 5½ in. shaft and special steel propeller.

The American schooner CHAS. BROWER,



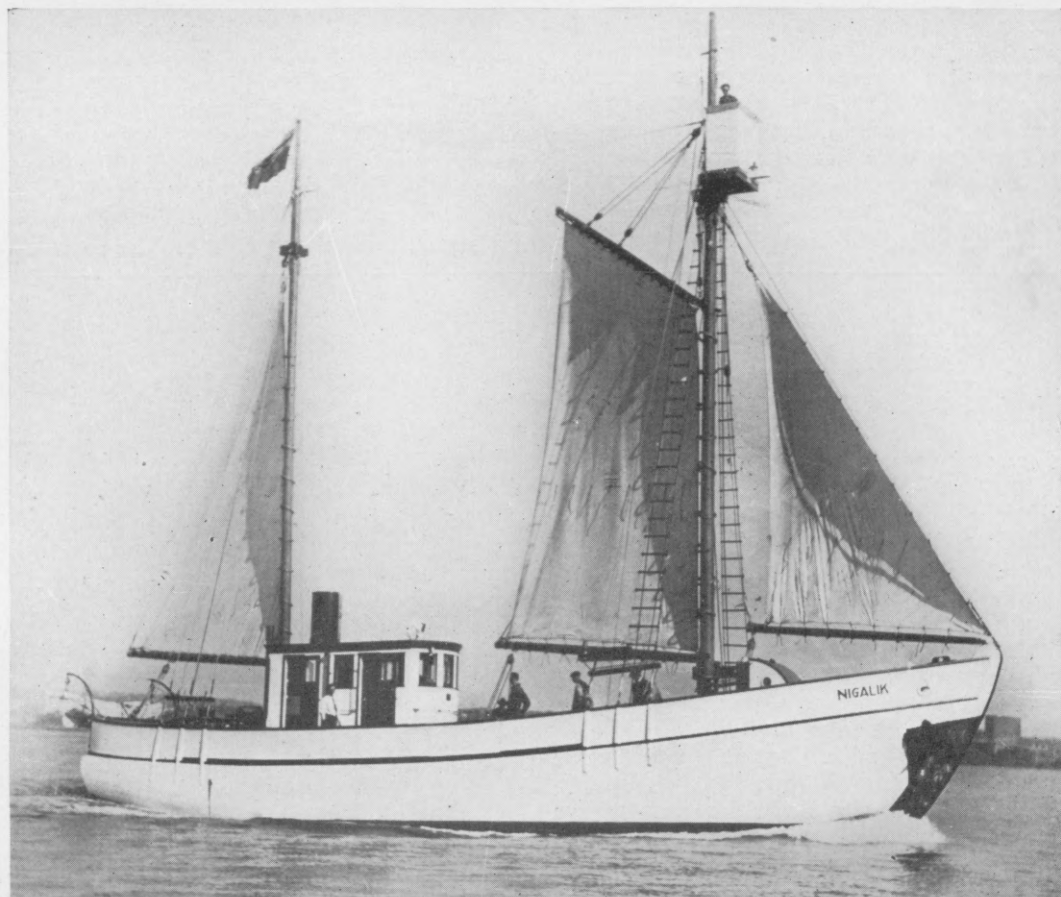
Baymaud, an oak-built auxiliary schooner, is powered with a surface ignition engine

operated by Liebes & Company and fitted with a 300 hp. Diesel engine, and the Northern Whaling & Trading Company's PATTERSON with a 400 hp. Bolinder engine, were scheduled to visit Herschel Island;

while the Hudson Bay Co. sent in the steamer BAYCHIMO as well as the BAYMAUD.

The ketch NIGALIK, built at Vancouver this year for Clarke & McGregor, is a ves-

(Continued on page 776)



Nigalik, a more modern type of auxiliary, has a full Diesel with pilot house control

Boston Has Course in Ship Operation

Massachusetts Institute of Technology Plans Unique and Valuable Instruction Course for Students of Shipping

UNIQUE in its facilities and broad in its scope, the Course in Ship Operation* which has been established at the Massachusetts Institute of Technology and is administered by the Department of Naval Architecture and Marine Engineering, should go far towards stimulating interest in the expansion of the American Merchant Marine and should attract to the operating side the right kind of talent. International competition in foreign trade is year by year more insistent in its demand that ships and their power plants be specially designed for a particular trade route, and that more attention be given to the problems of ship operation, rapid turn round in port, and the relations of land and water transportation.

Men with a knowledge of economics and business methods and a training in the fundamentals of the exact sciences and engineering should be particularly well qualified to visualize and analyze problems of ship operation after they have had the necessary practical experience with a ship-owning organization. The Course in Ship Operation is a combination of science, engineering, economics and business studies specially laid out to train men for activities in this field.

An ambitious programme of studies has been arranged to cover a period of 4 years, and one cannot help feeling that the student will have to work very hard indeed if he is to obtain the full benefit of all the subjects touched upon. It is planned to give a broad foundation in chemistry, physics, mathematics, drawing, English and history during the first two years, while during the last two years the time is devoted to engineering, economics, business studies, naval architecture, marine engineering and ship operation. Of these subjects the newest and most original is that of ship operation, and we think we are right in stating that

this is not covered in any other "shipping" university in the world. Furthermore, we judge it to be an indication that this country is thinking along the right lines in the business of shipping and is beginning to tackle, by supplying trained men, problems which hitherto have relied for solution solely on rule of thumb experience. It is upon these lines that America will eventually win her way back to her position among the merchant marines of the world.

Ship operation, in the course, has been subdivided into three sub-groups—administration, port and terminal facilities, and general matters, such as repairs, upkeep, docking, comparison of steam and Diesel engines for definite ships and trade routes, influence of the size and speed of ships on operating expenses; comparison of cubic and deadweight ships; design and economical operation of the ship's power plant, especially the auxiliary machinery; influence of form, coefficients, and proper characteristics on propulsion in rough weather; design of ships from the owner's point of view. These studies are taken in the fourth year, so that the student may apply the principles learned in his study of economics, accounting, naval architecture and marine engineering in the first three years of the course.

The subjects briefly outlined above cover a vast amount of what we may call heterogeneous knowledge existing in the dockets of shipowners and in the experience of superintendents and consultants, but not readily available in all cases to the student. Such knowledge is generally the reward of experience, rather than the immediate prerequisite of graduation. Nor do text books help the student very much in this way, although there is now a tendency for writers on shipping matters to produce works of not too technical a nature, which cater especially for this field. Types of ships, special cargoes, such as grain, coal and ore and their effect upon ship construction, elementary data on the practical

side of ship construction, the handling of cargoes at ports are all matters which have been recently dealt with under this head.

The instruction in ship construction and naval architecture given in this course is naturally not as extensive as that given to students pursuing the general course in naval architecture and marine engineering, but it is designed to give the student a thorough working knowledge of the technical and economic aspects of ship design and construction, rather from the point of view of the owner and operator than from that of the designer and builder. Nevertheless, the knowledge imparted is of a very thorough nature. An introductory course on marine engineering given in the third year takes up the study of boilers, reciprocating engines, turbines; combustion; fuels, combustion draft; condensers and condenser auxiliaries, feed-water heating and power plant layout.

It seems strange that no mention is made of Diesel engines until the last year and more especially as the public is constantly being educated to the fact that the future of the American Merchant Marine lies with the motorship. Shipowners realize this point more than any one, knowing as they do the competition their steam tonnage has to face from foreign-owned motorships. Is it fair, therefore, that the Course in Ship Operation should release on to the shipowner graduates with a lively appreciation of the merits of the steam freighter and with but a tardy knowledge of Diesel power?

Such, then, is a brief outline of the scope of the Course on Ship Operation. It is vastly comprehensive, it is ambitious, it is commendable, and it will have the good wishes of every one interested in shipping. American owners and operators will support it because of its national value. Foreign nations will do well to give it careful thought and will lose nothing thereby if they follow Boston's example.

Auxiliaries Capturing Arctic Trade (Continued from previous page)

sel of 72 ft. overall length by 22 ft. beam. She has a 75 hp. Atlas-Imperial Diesel engine, and is specially constructed for ice navigation. She left early in June for the Arctic.

Construction of NIGALIK has followed the best practices in vessels of her type. Frames are of sawn fir and there is 3½ in. fir planking. For added protection, an outside sheathing of ironbark has been included and the stem, in addition to being heavily braced on the inside to withstand the shock of breaking through thick ice, is itself of solid ironbark with an iron shoe and plates to protect the end of the planking. The stringers and deck timbers are also of exceptionally sturdy fir scantling.

Accommodations on NIGALIK were arranged with the view to securing the greatest possible economy of space. Berths are provided for five persons in the fore's'tle. On



Schooner Old Maid No. 2

the port side aft are berths for six more persons and on the starboard side a combination galley and dining saloon. Aft these quarters is a roomy lazarette with space

for miscellaneous stores and for a 200 gal. fresh water tank. The cargo hold, amidships, has a capacity of 75 tons.

The main power plant comprises a 75 hp. Atlas-Imperial Diesel engine turning a heavy 3 bladed bronze propeller. An over-size shaft, suitable for an engine of 125 hp. is installed. NIGALIK will have a cruising radius of about 5000 miles on a fuel capacity of 2400 gal. Pilot house control is fitted. A special gaff from the foremast has been included for hoisting the cargo, the lines being run from a winch drum on the anchor windlass. This windlass itself is driven from a shaft connected to the main engine by a sprocket chain. Moderate sail is carried both for emergency and for steadying the boat in a seaway.

On her trial trip, NIGALIK made a speed under power of 7 knots, which is considered very good considering the fact that the boat, which has a beam of 22 ft. and a draft of 6½ ft., is so heavily constructed and is not specially designed for speed.

* See handbook entitled, "The Course in Ship Operation," published June, 1926, by Massachusetts Institute of Technology.

Big Busch-Sulzer Engines Completing

Are Six-cylinder 3000 b.hp. Units Constructed for the Shipping Board Conversions

WITH the completion of work on the last two units for the U. S. Shipping Board conversions, Busch-Sulzer output of large marine Diesels for the last eighteen months will total six engines, with a collective horsepower of 15,000 s.hp. This figure includes four 3000 b.hp. units for the Shipping Board conversions and two 1500 b.hp. units for installation in the Standard Oil Co.'s tanker E. T. BEDFORD, now undergoing conversion at the Federal S.B. Co.'s plant at Kearny, N. J. These latter engines have the same cylinder diameter as the Shipping Board units, but a slightly shorter stroke.

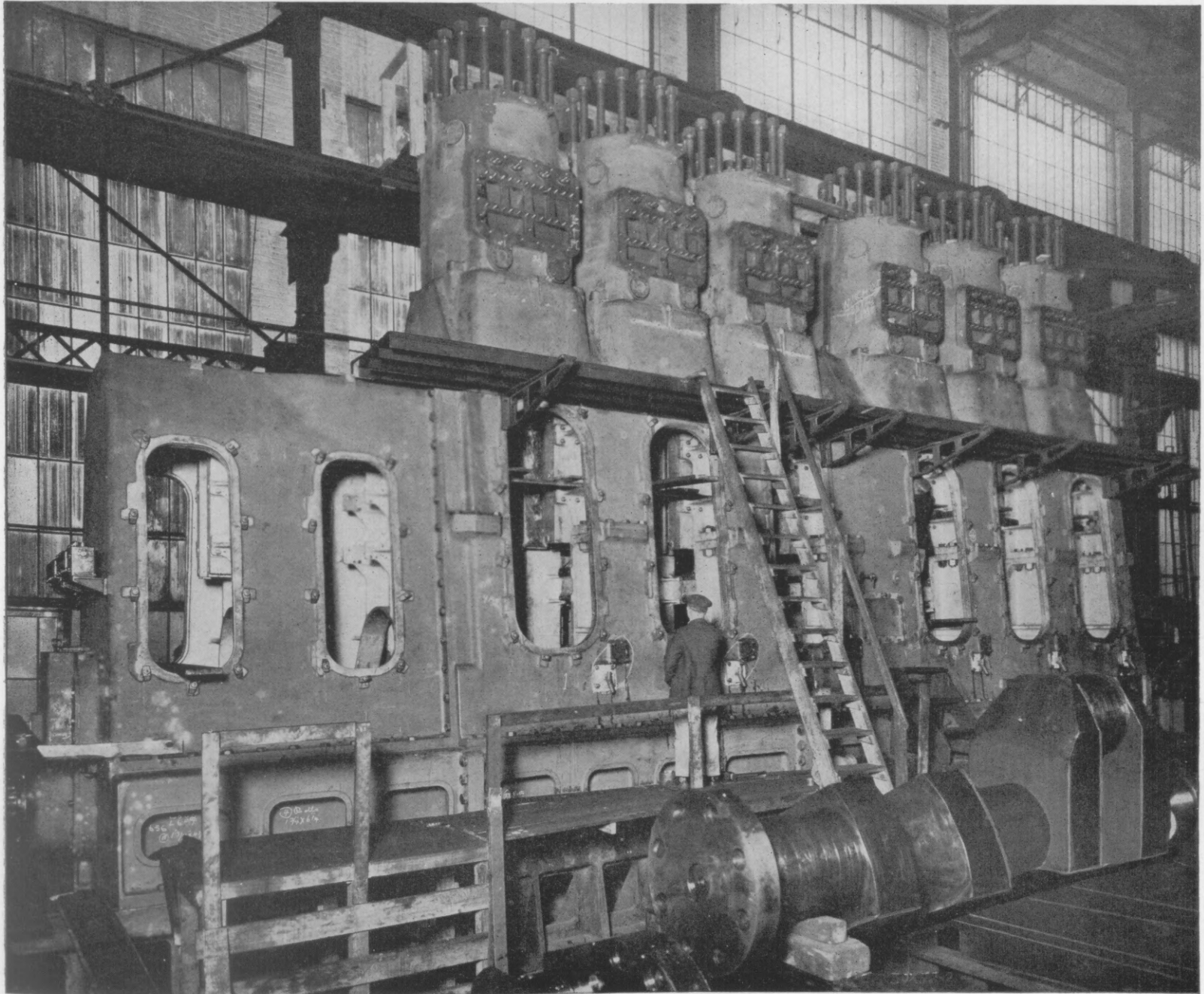
The two 3000 b.hp. units completed are to be installed in the freighters SAWOKLA and CITY OF RAYVILLE by the Newport News S.B. Co., to whom the contract was awarded in April last on a bid of \$768,900, while the second two units will be installed

in two out of the three freighters SEMINOLE, YOMACHICHI, and CITY OF DALHART. Bids for these installations were opened at the office of Capt. R. D. Gatewood, Manager of the maintenance and repair department of the Shipping Board in New York on September 1. The first of the four Busch-Sulzer engines for the Shipping Board conversions ran a 30-day test from March 18 to April 17, and the second engine finished successful trials early in August.

Characteristics of Bush-Sulzer Engine	
Power	3000 b.hp.
Number of Cylinders	6
Bore	30 in.
Stroke	52 in.
Speed	90 r.p.m.
Piston speed	780 ft. p.m.

The Busch-Sulzer marine Diesel engine is

of 2-cycle, slow-speed, heavy-duty, cross-head, direct reversible type, having six working cylinders, using full compression and air injection system of fuel atomization. It is of the fully enclosed crankcase type, fitted with forced feed lubrication and designed for single-screw installation, with a right-hand propeller. The engine may be run continuously at any speed between 35 and 95 r.p.m., as no harmful criticals fall within this range. It is self-contained, with attached fuel measuring pumps, air injection compressor and scavenge pump. The base is of the cast iron design, made in sections. The bottom of the bedplate has sloping sides to collect lubricating oil. The crank-pit is cast integral with the base. The crankcase is divided horizontally, the upper portion through the working cylinder being in two pieces, each carrying three working cylinders, affording, when tied



Busch-Sulzer engine for the Shipping Board Conversions is a 6-cylinder 3000 hp. unit of fully enclosed crankcase type

through the lower sections to the bedplate, a rigid construction and even distribution of the load throughout the structure.

The crankshaft is of solid forged type, made up of two interchangeable three-crank main sections, and one air compressor and scavenge pump section. The connecting rods are of typical marine design, with cast steel crank and connecting rod boxes. The crosshead guides are oil cooled, and adjustment is provided by shims under the guides.

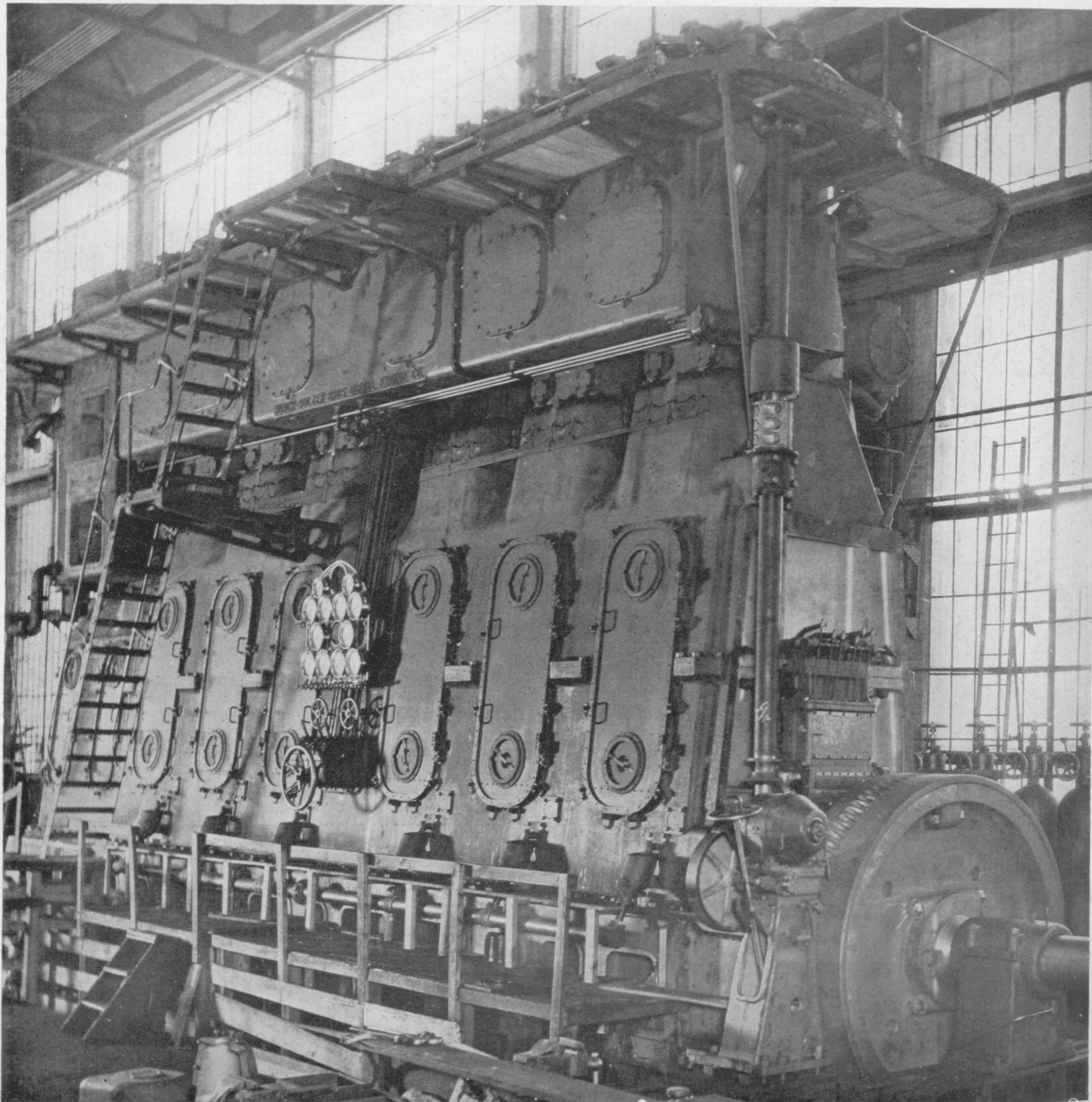
The piston rods, which in this slow-speed engine are subject to compression stresses only, are of hollow steel. The pistons are water cooled through a system of telescopic pipes. The cylinder liners are fitted with the usual double row of scavenge ports employed in the Sulzer scavenging system, and

they have also piston controlled exhaust ports. The cylinder heads have only a single central opening for the combined fuel and starting air valve cage.

The scavenge pump is of tandem double-acting type, driven from the main crank shaft at engine speed. The valves are of reed type, the same valves being used on both scavenge pump and working cylinder ports, except that the latter are automatic in operation.

The cam shaft operating the fuel injection, starting, and reversing valves is driven from the main crank shaft through gears and a vertical shaft. These gears are lubricated from the force feed system. A double set of fuel and starting cams is provided for ahead and astern running.

Each valve lever is fitted with a short link carrying two rollers, which communicates the motion of the cams to the lever. The entire reversing process consists merely in adjusting the position of these short links in such a way that one of the rollers rests on the cam for ahead running and the other roller on the cam for astern running as required. The action is very simple and very little effort is needed for its operation. In addition to functioning to reverse the engine, the motion of the short links is also used to vary the lift of the fuel valve and the duration of its opening, and this permits the gear to be so arranged that the fuel valve opens exactly at the moment most suitable for the conditions under which the engine is operating.



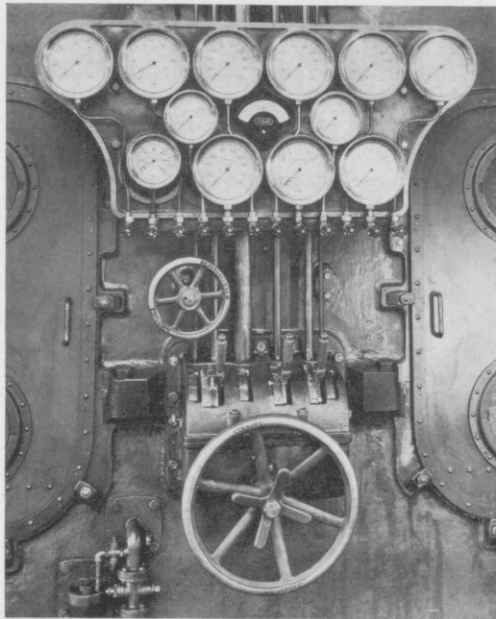
Control for the 3000 hp. Busch-Sulzer Shipping Board engine is at mid length on engine room floor level

The starting air valves are similarly equipped, operating in conjunction with the fuel valves by the air operated servo-motor, controlled from the operating station. During maneuvering tests, reversing was carried out in 7 sec., and at the same time the engine was successfully started with air pressure as low as 150 lb. per sq. in.

An oversize air compressor is fitted to provide excess air when maneuvering. It is mounted in line with the working cylinders, forward of the scavenge pump, has three stages, and is driven directly from the main engine crankshaft.

Unlike the majority of Sulzer engines, in which the maneuvering gear is located at the elevation of the operating platform, the Busch-Sulzer gear is placed at a convenient level for operation from the engine room floor level. It is normally actuated by servo-motor, although capable of manual operation. The mechanism is provided with a patented interlocking device, which automatically prevents the reversing gear being moved while either the fuel valves or starting valves are being operated, and to obviate these valves being made operative before the reversing of the gear has been completed. An automatic control is provided for the operating gear, by means of

which the engineer on watch puts the reversing wheel into ahead or astern position, as may be required, thus starting the engine. When all six cylinders are operating



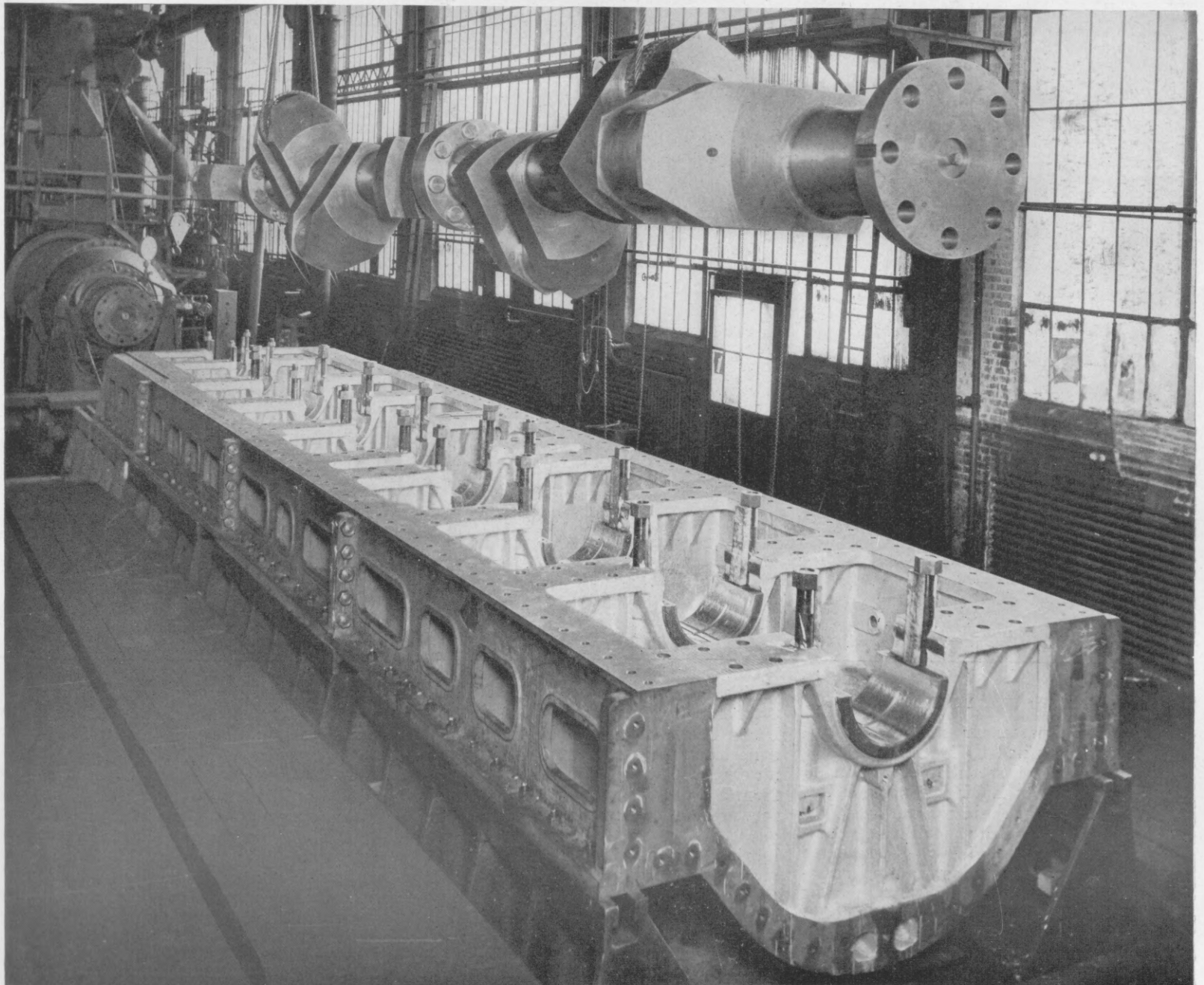
Engine controls

on fuel, the actuating air motor automatically shuts down and the maneuvering gear remains in running position.

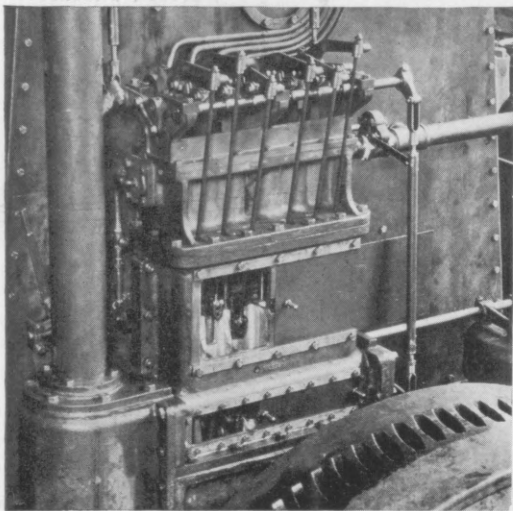
The fuel pump is located at the aft end of the engine, readily accessible from engine room floor level. It is fitted with one plunger for each of the six fuel valves. The amount of oil injected is controlled by the period during which the suction valves are held open, and this period is regulated directly from the operating station, being subject to complete suspension under the action of the overspeed governor. The governor is so arranged that it will prevent racing in bad weather and cut off fuel when the engine speed exceeds approximately 10 per cent above normal.

The working and compressor cylinders are supplied with lubrication from force feed lubricators, accessibly located at the forward end of the engine, near the engine room floor level, and gear driven from the crankshaft. The turning gear is operated by an electric motor and provided with an interlocking device to prevent admission of starting air to the working cylinders while the turning gear is in mesh with the rack on the fly wheel.

Above the control station a gauge board is mounted, carrying in addition to the



Base is of cast iron made in four sections, and crankshaft is of solid forged type with two interchangeable sections



Plunger type fuel oil pumps

usual gauges, a Sperry electric revolution counter and tachometer.

For the first engine the summary of test results tabulated below is reproduced from the June issue of *MOTORSHIP*. When tested, the engine was running against a Heenan & Froude hydraulic dynamometer of 9000 b. hp. capacity, purchased especial-

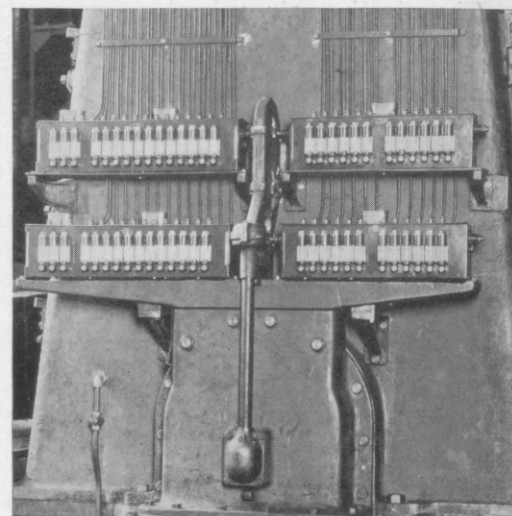
ly for the testing of these Shipping Board engines, and calibrated by Geo. H. Walker, Chief Engineer, Heenan & Froude, Worcester, England, in the presence of representatives of the United States Shipping Board, before starting the test, at St. Louis.

The average mean indicated pressure of 82.44 lb. per sq. in. realized is 2.56 lb. per sq. in. below the figure specified by the Shipping Board, and the engine has been designed for safe operation at 105 r.p.m., at which speed it would develop 4000 b. hp. at mean indicated pressures and piston speeds within conservative limits.

Summary of Test Results

Average power	3011 b. hp.
Average speed.....	89.24 r.p.m.
Average mean indicated pres...	82.44 lb. sq. in.
Average mech. efficiency.....	73.53 per cent
Total fuel consumed (tons of 2240 lb.)	
per 24 hours.....	13.34 tons
Fuel consumption per i. hp. hour...	0.3041 lb.
Fuel consumption per b. hp.....	0.4133 lb.
Average lub. oil (all purposes)	
per 24 hours.....	21.7 gal.

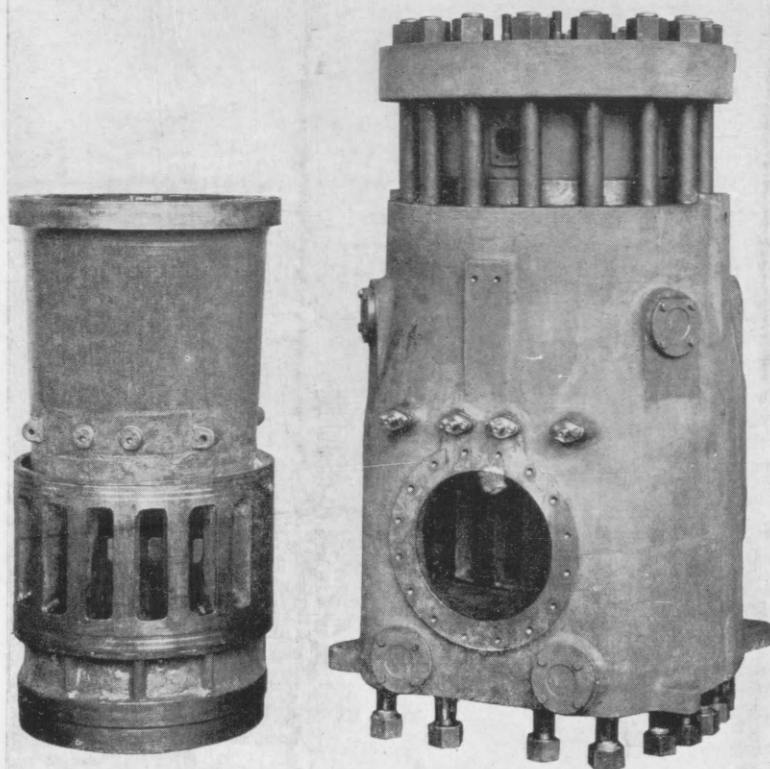
The average fuel consumption during the first 15 days of the 30-day run was 0.4096 lb. per b. hp. hour and on the fifteenth day averaged 0.4067 lb. per b.hp. hour for



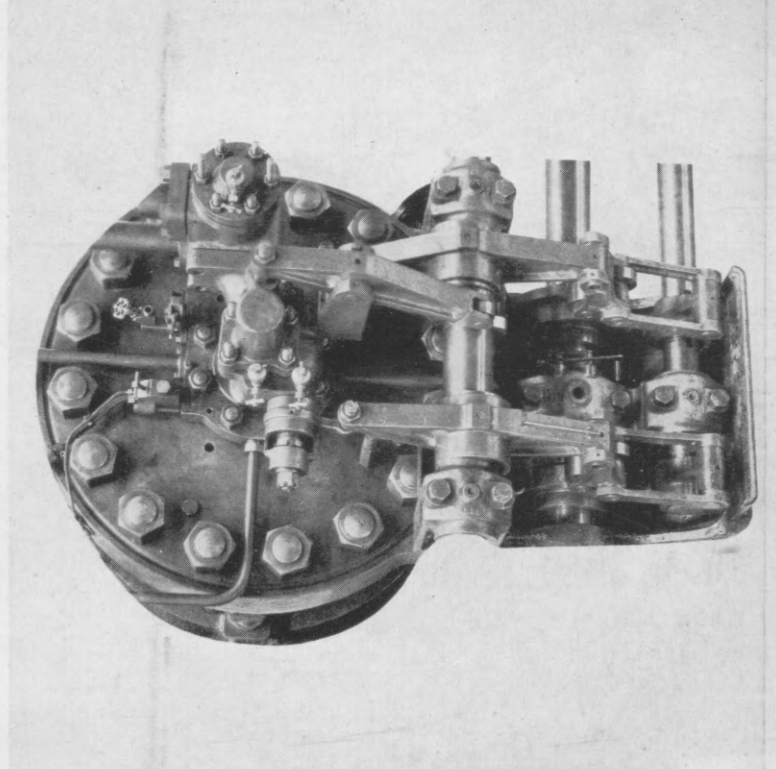
Lubricating arrangement

24 hours, Mid-Continent fuel oil of good grade of about 29 deg. Baume being used.

The fuel used during the first 15 days of the run was 27 deg. Baume, with a heat value of 19.415 B.t.u. per lb., changed for the second half to fuel of 25.1 deg. Baume, with a heat value of 19.178 B.t.u. per lb.



Cylinder and cylinder liner



Cylinder head and valve gear

West African Passenger Motorliner

ACCRA, latest passenger motorliner constructed and engined by Harland & Wolff Ltd., Belfast, has recently been handed over to her owners, Elder Dempster & Co., Ltd., for service in their Liverpool-West African trade, in which she will run in conjunction with ABA, world's first passenger motorliner which has been running satisfactorily for almost five years. The new vessel which has a length overall of 468 ft. 9 in., breadth molded of 62 ft., depth molded of 35 ft. and gross tonnage of 9936 tons, is powered by two sets of H. & W.-B. & W. 6-cylinder double-acting, 4-cycle Diesels of similar design to the type of

engine fitted in *ASTURIAS* of R. M. S. P. Co., and in *CARNARVON CASTLE* of the Union Castle Co. These engines each have a normal rating of 3750 hp. Compressed air for fuel injection purposes is provided from a 3-stage compressor mounted at the forward end of each engine and driven off an extension of the crankshaft. Forced lubrication is used throughout the engines and oil is also used for piston cooling. Cylinder jackets and covers are fresh water cooled. Maneuvering air at 25 atm. pressure is stored in four steel reservoirs which are charged by two 2-stage compressors driven by electric motors. Three Diesel generators supply the current required for lighting, heating and power throughout the

vessel. The only steam on the ship is that generated by an oil-fired vertical boiler for fuel heating, distilling and minor emergency purposes.

ACCRA has six decks and seven watertight bulkheads, dividing the hull into eight compartments. The double bottom which extends the full length of the ship is arranged to carry fuel oil and water ballast. The vessel has a cruiser stern and single low funnel. Accommodation is provided for 500 passengers.

Dredge tender *MANTEO* is being powered by a 4-cylinder Bethlehem Diesel developing 110 s.hp. at 375 r.p.m. This vessel is owned by the Army Engineers.

First Diesel-Electric Railroad Ferries

Southern Pacific to Construct Two 256 ft. Vessels with
Four 450 b.h.p. Diesel Driving Generators

SOUTHERN PACIFIC RAILROAD is to construct two Diesel-electric automobile ferries for service on San Francisco Bay, either between Sausalito and San Francisco or Oakland Pier and San Francisco. These two ships will be the first Diesel ferries owned by any American railroad. Bids were asked in July on three or five such vessels and a definite award has now been made for the construction of the Diesel units to the New London Ship and Engine Co.

General Electric Co. will supply the generators and the Bethlehem Sb. Co. will construct the hulls. Each ferry will cost \$625,000. The ships will be built on the transverse system, the hull being divided into eight watertight compartments.

Southern Pacific Ferry Characteristics

Length o.a.	256 ft. 0 in.
Length b.p.	234 ft. 0 in.
Beam, molded	44 ft. 10 in.
Beam, over guards	61 ft. 3 in.
Depth, molded (guard side)	19 ft. 5½ in.
Draft	11 ft. 3 in.
Auto capacity	80
Passenger capacity	500

The engine bedplates are to be bolted directly to plates riveted to the reverse bars

and intercostals, and side keelsons are to form girders under the holding down bolts. Four main Diesels are each direct connected to 275 kw. generators, and will supply power to two double armature motors of 1250 hp. each, arranged on the centerline of ships in the main engine room amidships. Ward-Leonard control will be provided for double pilot house and one engine room control station. Exciters on the main generator will furnish power for auxiliaries and for lighting the ship. The characteristics of the Nelseco engines selected are as follow:

Southern Pacific Ferry Engines

Power	450 b.h.p.
Revolutions	250 r.p.m.
Number of cylinders	6
Bore	14½ in.
Stroke	22 in.
Piston speed	917 ft. per min.
M.e.p.	65 lb. per sq. in.

Price is said to be in the neighborhood of \$49.00 per horsepower, with the engines rated at 450 b.h.p., or \$55.00 per horsepower at 400 b.h.p. rating.

San Francisco has had Diesel electric ferries for some years operated by the Golden Gate Ferry Co., but to date this Southern

Pacific contract represents the first venture of any railroad company in Diesel or Diesel-electric ferries, and may be cited as a further example of the way in which the West Coast leads the East in the application of oil engines to certain types of ship. New York is this year to have privately owned Diesel-electric automobile ferries operating on the Hudson, while a prominent Eastern railroad is reported to have the whole of its large ferryboat fleet scheduled for conversion to Diesel drive as soon as the existing machinery in each unit requires extensive overhaul. The Department of Plant and Structures in the city of New York has asked for bids on a small ferry, but no award has as yet been made. These are all indications that the steam-driven ferry is slowly and gradually being superseded. Most new construction is Diesel propelled, while old vessels when overhauled are invariably Dieselized.

Diesel-electric propulsion is in many ways ideal for ferry work, not only from the point of view of economy—Southern Pacific expects to save \$80 per day in a 16-hour day on fuel costs alone in its new vessels—but also from the superior maneuvering ability which is given, compared with steam. There are also no lay by losses.

Speed Paramount in Far Eastern Trade

Kerr Lines Replace 11 Knot Motor Freighters with 14½
Knotters and Make Competition for Prince Line

FASTER motorships are now the rule on many routes and in such trades the 11 knot motor freighter is almost as obsolescent as the steamer. This is a definite step forward which is having far reaching effects, although it does not mean that the 11 knot motorship is a thing of the past because there are still many trades—particularly the bulk cargo trades—in which the slower ship can demonstrate her superiority over the uneconomical steamer. The demand for speedy transport is particularly well illustrated in the trade from New York to the Far East, outward via Panama and homeward via Suez and the Mediterranean. This trade has been virtually revolutionized this year with the appearance of five new 14½ knot motor freighters operated by Furness Withy for the Prince Line.

Kerr Lines, Inc., who are direct rivals of Prince Line on this route are gradually replacing their existing fleet of six 11 knot 8000 ton d.w. motor freighters by six 9000 ton d.w. motorships of practically the same speed as the Furness vessels. The result of this competition will be that, including the five Prince Liners, by 1927 eleven of the fastest and best equipped motor freighters in the world will be operating on regular schedules to the Far East from New York. SILVERASH, first of the new

Kerr fleet, is scheduled to take her maiden sailing from New York on October 25 and will be followed by a second vessel one month later. The slower ships, as relieved, will be transferred to routes where speed is not of paramount importance.

The new ships which are named respectively SILVERASH, SILVERBELLE, SILVERGUAVA, SILVERMAPLE and SILVERHAZEL are being constructed and engined in British shipyards. J. L. Thompson Co. and Sir J. Laing & Sons, Ltd., Sunderland, are each building three vessels and Doxfords are fitting the engines in all six. Following are the principal characteristics of the ships:

Characteristics of New Silver Liners

Length b.p.	425 ft. 0 in.
Beam, molded	58 ft. 3½ in.
Depth, molded	29 ft. 0 in.
Deadweight capacity	9000 tons
Power	5000 b.h.p. approx.

The ships have slightly smaller overall dimensions than the Prince Liners, as a reference to the article in our September issue dealing with the Prince ships' performance, shows. Their maximum developed power—about 5000 b.h.p. at 90 r.p.m.—is given by a single 4-cylinder Doxford opposed piston engine with cylinder diameter 26½ in. by 54 in. stroke. The Prince

Liners develop about 5600 b.h.p. at 125 r.p.m. with two A. E. G.-B. & W. engines having cylinders 89½ in. diameter by 47 in. stroke. It is expected that the two rival fleets will attain on service a speed of 13½ to 14½ knots.

Equipment on the new Silver Liners will be of the most modern type comprising all-electric deck and engine room auxiliaries. The derrick equipment includes 35 ton units and the hatchways have been specially designed with a view to handling large bulky pieces of machinery, such as from time to time will be included in the vessel's outward general cargo from this country. Ample 'tween deck space has been provided to take care of the smaller packages while a deep tank, subdivided longitudinally, is fitted for the carriage of vegetable oils in bulk. These latter may comprise coconut oil, wood oil from Chinese ports, or latex from Manila. Steam heating coils are fitted in these tanks to reduce the viscosity of any liquid cargo which may require to be unloaded in cold weather.

Kerr Line's ports of call approximate very closely to those of the Prince Line except that generally a few more ports are included in the itinerary. The outward voyage is considered to terminate at Manila, after which the return is made via the Dutch East Indies and Colombo.

Review of Recent Publications

Ship Model Making

By Capt. E. Armitage McCann. 6¼ x 9½ in. 12pp. Price \$2.50. Published by The Norman W. Henley Publishing Co., 2 W. 45 St., New York.

Those interested in the ships of past ages, before it was even imagined that sail would give place to steam, just as steam is giving place to oil, will find pleasure in reading *Ship Model Making* which tells how any handy person can make models of a Barbary Pirate Felucca, a Spanish Treasure Galleon, and other similar craft with a few simple tools and almost without expense.

The text describes how to construct the models' hulls, what material to use, how to fasten together and color them, how to make the spars and to rig the ship.

Atlantic Coast Pilot. Cape Cod to Sandy Hook

By the U. S. Coast and Geodetic Survey. 5½ in. x 9 in. 394 pp. Price 75 cents. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C.

A new edition of the *Atlantic Coast Pilot*, Cape Cod to Sandy Hook, will be welcomed by all those who are still using the 1918 edition which is not only now 8 years out of date, but which was not as completely revised in 1918 as it would have been if the state of war then existing had not handicapped the Coast and Geodetic Survey staff. Preparation of the new edition included a special examination by the Bureau of the entire region covered by the book, and of course a number of additional sources of information have also served in the compilation. In addition to the revised sailing directions the book contains new features, e. g., the signals of the radio beacons on this part of the coast, all soundings in meters as well as in feet and inches, etc. Like all Government publications of aid to navigators the *Atlantic Coast Pilot* is sold at a price to cover only cost of paper and of printing. No commercial house could produce such a book for 75 cents.

From Slip to Sea

By A. C. Hardy, B. Sc., A. M. Inst. N. A., A. M. I. Mar. E. 5¼ in. x 8¼ in. 252 pp. Price 10s 6d. Published by James Brown & Son, Glasgow, Scotland.

Again selecting a subject which has hitherto been missing from marine bibliography, Mr. Hardy who already has three books on new

subjects to his credit—*Motorships*, *Merchant Ship Types* and *Bulk Cargoes*—has in his most recent work filled a void that existed among books for students of naval architecture. This volume relates how a steel vessel is built, how the hull is erected, how the templets are made, the frames bent, the plating finished and every part of the structure completed. The author, who himself served a 5 years' apprenticeship in a shipyard before taking his college course in naval architecture, evidently has noted how seriously handicapped many young students are by lack of practical knowledge. He states in his preface "one often finds students studying theoretical naval architecture and discussing, for example, the longitudinal strength of a ship on a standard trochoidal wave, when they cannot even appreciate the difference between a keelson and a stringer." For the aid of such students and for the benefit of all those who would learn what are the various successive stages in the construction of a steel vessel and how the structure is put together, this book has been written. No book of similar character has previously been offered by a publisher in any country. There are many who can learn much by reading it. Written in plain, simple language, illustrated by many sketches as well as half-tones its contents are clear and easily assimilable.

Personal

R. D. Gatewood director for the New York district and manager of the bureau of maintenance and repair for the Fleet Corporation has been relieved of the former post by W. G. Griffiths. It was first planned to move the bureau to Washington, with Captain Gatewood in charge, but it is understood that General A. C. Dalton, president of the Fleet Corporation, has decided to continue the headquarters of the office in New York under Captain Gatewood.

George Uhler, former Supervising Inspector General of the Steamboat Inspection Service, died recently at Washington. He retired from the post December 31, 1925, after having held the position for nearly 23 years.

Joseph Hecking has resigned the position of Engineer-Surveyor, held so many years with the American Bureau of Shipping, in order to accept a position in the Oil Engine Sales and Engineering Department of the Bethlehem Shipbuilding Corporation at Elizabeth, N. J. Mr. Hecking entered on his new duties on Sept. 13th.

how to do it, and the only way to know that it is being done is to check up on progress.

When you place the hand grinding wheel on the grating over the thrust bearing, don't blame the lubricating oil because there develops a high temperature and excessive rate of wear in the thrust bearing.

The man who knows more about the other fellow's job than the other fellow does, is not spending enough time keeping himself posted in his own work.

Starting an Oil Engine with Steam

On a certain dredge, states a correspondent, steam is employed for starting a Diesel motor, and the fact that such a combination works out admirably has attracted a considerable amount of attention, some people even going so far as to say that this is the first time anything of the sort has ever been done.

That is not the case, however, and only goes to show how different circumstances have a different bearing on certain cases.

Some years ago—it was during the war—a motor tanker with oil engine propelling units and steam auxiliary machinery and loaded with airplane gasoline became so badly crippled that she drifted about in the war zone in a helpless state for want of compressed air.

Everyone aboard the ship was in a nervous state bordering on collapse, and desperate in the extreme. What the engineers did under these circumstances is therefore not surprising, while the fact that news of it never leaked out is easily accounted for in view of the fact that whole armies were being wiped out in Europe, ships were being torpedoed and the world was topsy-turvy with events far outshadowing the desperation of a handful of men on a little tankship.

The seriousness of their plight was none the less disturbing to them for all of this. The engineers made temporary steam connections between the boiler and the air bottles and then fastened down the safety valve and fired up. It was necessary to place almost twice the pressure allowed by the steamboat inspectors on that boiler to make an equivalent of the air pressure used. They did it, and started the engines. The ship is still running, and the incident is forgotten by all save a few. And now comes along a dredge doing the same trick, only taking no chance of damaging anyone or anything and we hear about it.

It just reminds us that if we only knew everything which went on during that war we might claim less as being entirely new and never tried before.—A. B. N.

Mess Room Maxims and Fables

You can take a piece of machinery apart very effectively with a cold chisel and hammer, acetylene torch or even a little nitro-glycerine, but when it comes to putting it together again, well that's another story.

Marking things when disassembling an engine helps in getting the parts back in their original order, but when every Tom, Dick and Harry has used a private mark, it sometimes takes longer to decide which mark is which than would be spent in a trial of several different assemblies.

Painting an engine without first cleaning it should make a man feel about as he would in putting on clean underwear without first taking a bath.

The engine is no more dependable than the water circulating pump.

No use to go into a rage over a troublesome piece of equipment. It will demand more attention than a good one, and you will have to give it; so that's that.

However, there is little excuse for neglecting the better sort of equipment just because it will bear such neglect.

After an air cooler blows up it is too late to save it by reducing the amount of compressor lubricant, but it is not too late to save the next cooler.

To prime up the fuel valves is quicker and easier than to pump up a tank of starting air, and in any event no amount of turning the engine will set the fuel pumps working when they are air-bound.

Standing by the "throttle" while the ship is pitching and the engine racing is easier than keying up on top and bottom ends.

During port repairing periods we work too much overtime during the last 24 to 48 hours before the ship sails and spend too much time talking things over and doing nothing during the first 24 to 48 hours.

The only sensible means of getting a job done is to turn it over to someone who knows

Classified Advertisements

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